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THESIS

A STUDY ON THE POTENTIAL COST SAVINGS ASSOCIATED WITH IMPLEMENTING AIRLINE PILOT TRAINING CURRICULA INTO THE FUTURE P-8 MMA FLEET REPLACEMENT SQUADRON

by

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June 2006

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13. ABSTRACT (maximum 200 words)

   This thesis discusses potential cost savings associated with implementing airline pilot training curricula into the future P-8 Multimission Maritime Aircraft (MMA) Fleet Replacement Squadron (FRS). These curricula rely primarily on high-technology flight simulators and do not require any flight time in an actual aircraft. This thesis also provides an approach for estimating future P-8 FRS cost savings. The results of this thesis indicate that significant savings will likely accrue in the areas of fuel, Aviation Depot Level Repairables (AVDLR) and training expendable stores costs if airline pilot training curricula are implemented into the P-8 FRS in FY 2014. Further research is needed in many other cost areas before additional cost savings estimations can be made. Finally, this thesis discusses many additional considerations that should be taken into account before a future airline pilot training curricula implementation decision is made.

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I. INTRODUCTION

A. BACKGROUND

In 1997, Secretary of Defense William S. Cohen initiated the Defense Reform Initiative (DRI) to improve the way business was being conducted within the Department of Defense (DoD). One section of this initiative directed military communities within the DoD to begin adopting some of the best business practices of the private sector. Cohen understood that doing so would allow military communities to reduce their operational expenditures and operate in a more cost-effective manner. He also understood that doing so was necessary if the United States was to carry out its "defense strategy into the 21st Century with military forces able to meet the challenges of the new era…" [From Ref. 1]

Great progress has been made in adopting some of the best business practices of the private sector since the time of Cohen's DRI, but more progress in this area can be made. For instance, some military aviation communities such as the Navy Maritime Patrol Community could begin to train pilots in a way that more closely reflects what is seen in the commercial airline industry. Pilots in the commercial airline industry are trained primarily in high-technology flight simulators whereas pilots in the Navy Maritime Patrol Community's Fleet Replacement Squadron (FRS) are trained primarily in actual aircraft.

This thesis examines some of the potential future cost savings that would accrue if the Navy Maritime Patrol Community did alter its FRS pilot training practices for the new P-8 Multimission Maritime Patrol Aircraft to more closely reflect what is seen in the commercial airline industry. Before doing so, background information on the pilot training methodologies and technologies currently being used at the Navy Maritime Patrol FRS and JetBlue Airways is provided. The pilot training methodologies and technologies currently being used at JetBlue Airways are representative of what is seen throughout most of the commercial airline industry.

B. OBJECTIVE AND SCOPE

The main objective of this thesis is to discuss and, where possible, provide estimates of the potential cost savings associated with implementing airline pilot training curricula into the future P-8 FRS. It is also to develop an approach for estimating

potential future cost savings when cost savings estimations cannot be made. This study will be useful to policy-makers in the Navy Maritime Patrol Community who are interested in practical ways to reduce spending.

C. RESEARCH QUESTIONS

This thesis addresses the following research questions:

1. Primary

1. What are the potential, future cost savings associated with implementing airline pilot training curricula, which rely primarily on high-technology simulators, into the future P-8 Multimission Maritime Aircraft (MMA) FRS?

2. Secondary

1. How is pilot training conducted at the current Maritime Patrol (P-3) FRS in Jacksonville, FL? What training techniques are used there? How might pilot training be conducted at the Navy Maritime Patrol FRS in the future?

2. How is pilot training conducted at JetBlue Airways? What training techniques are used there? How do these training techniques compare to the ones being used at the Navy Maritime Patrol FRS?

3. What are the capabilities of the high technology simulators used by JetBlue Airways and other commercial airline companies?

4. What non-cost savings related considerations should be taken into account before airline pilot training curricula are implemented into the future P-8 MMA FRS?

5. If airline pilot training curricula are implemented into the future P-8 MMA FRS, should they be modified to include some actual flight time for pilots who have very little flying experience in an actual aircraft?

D. METHODOLOGY

Background information on VP-30 (the P-3 FRS) and its training structure was obtained from the VP-30 Pilot Training Office. Background information on the training technologies employed at VP-30 was obtained from the squadron's Simulator Maintenance Office. Naval Air Systems Command (NAVAIR) provided a copy of the contract for P-3 simulator instruction and maintenance.

Background information on JetBlue Airways and its training structure was obtained largely through company publications and telephone interviews with a JetBlue pilot. Background information on the training technologies employed at JetBlue Airways was obtained from the company's simulator programs coordinator.

The P-8 MMA Program Office in Patuxent River, Maryland provided information on the training plans and structure of the future P-8 MMA FRS. It also provided operational cost data for the P-3 FRS and some projected cost data for the P-8 FRS. This information was used to estimate the potential cost savings associated with implementing airline pilot training curricula into the future P-8 FRS. Some cost data was unavailable or was not collected which prevented some cost savings estimations from being made. In these instances an approach for estimating potential cost savings was developed.

Supplemental information for this thesis was obtained from many organizations including the 201st Airlift Squadron at Andrews AFB, Boeing and Flight Safety International. Supplemental information was also obtained from articles, government publications, internet websites and previous theses.

E.   CHAPTER ORGANIZATION

This thesis is divided into six chapters. Chapter I is the introductory chapter. It describes the rationale for this thesis research. It also describes how this thesis will address the primary and secondary research questions that are listed in Section C.

Chapter II describes how pilot training is currently being conducted at the P-3 FRS. It also provides information related to the training plans and structure of the future P-8 MMA FRS.

Chapter III describes how pilot training is currently being conducted at JetBlue Airways. The pilot training at JetBlue is representative of what is seen throughout most of the commercial airline industry.

Chapter IV discusses and estimates some of the potential cost savings associated with implementing airline pilot training curricula into the future P-8 FRS. It also provides an approach for estimating some potential, future FRS cost savings.

Chapter V discusses some additional considerations that should be taken into account before an implementation decision is made. Many of these considerations are non-monetary in nature.

Chapter VI summarizes the data in previous chapters and provides answers to the primary and secondary research questions listed in section C. It also provides suggestions for further research related to the Navy Maritime Patrol Community's use of airline pilot training curricula.

II. NAVY MARITIME PATROL FRS PILOT TRAINING

A. PURPOSE OF CHAPTER

This chapter is intended to give the reader an understanding of how Navy Maritime Patrol pilot training is currently being conducted at the P-3 Fleet Replacement Squadron (FRS). It is also intended to give the reader an understanding of how Navy Maritime Patrol pilot training may be conducted in the future once the P-8 Multimission Maritime Aircraft (MMA) FRS is established. Particular attention will be given to VP-30's pilot training curricula, which are traditional and rely heavily on flight time in an actual aircraft.

B. VP-30

VP-30 is the U.S. Navy's Maritime Patrol FRS. Its mission is to "provide aircraft-specific training for pilots, Naval Flight Officers, and enlisted aircrewmen prior to reporting to the fleet". [From Ref. 2] Each year VP-30 trains approximately 700 officers and enlisted aircrew with a staff of more than 1100 personnel and a fleet of more than 30 aircraft. Since its establishment in 1960, the squadron has epitomized professionalism in Naval Aviation. [From Refs. 2 and 3]

C. AIRCRAFT-SPECIFIC TRAINING

1. Now

Student pilots at VP-30 are trained to fly military missions around the world in the P-3C Orion and the EP-3E ARIES II. The P-3C is a long-range anti-submarine and maritime patrol aircraft manufactured by Lockheed Martin. It is powered by four Allison T-56-A-14 turboprop engines and is capable of carrying a mixed payload of depth bombs, missiles, mines, rockets, and torpedoes. The P-3C has a maximum speed of 411 knots (466 mph) and a range of approximately 2,380 nautical miles (2,738.9 miles). [From Refs. 4 and 5] Additional characteristics of the P-3C Orion are listed below in Table 1.

- Primary Function: Antisubmarine warfare (ASW)/Antisurface warfare (ASUW)
- Contractor: Lockheed Martin Aeronautical Systems Company
- Unit Cost: $36 million
- Propulsion: Four Allison T-56-A-14 turboprop engines (4,900 shaft horsepower each)
- Length: 116 feet 7 inches (35.57 meters)
- Wingspan: 99 feet 6 inches (30.36 meters)
- Height: 33 feet 7 inches (10.27 meters)
- Weight: Max gross take-off: 139,760 pounds (63,394.1 kg)
- Speed: maximum – 411 knots (466 mph, 745 kmph); cruise – 328 knots (403 mph, 644 kmph)
- Ceiling: 28,300 feet (8,625.84 meters)
- Range: Maximum mission range – 2,380 nautical miles (2,738.9 miles); for three hours on station at 1,500 feet – 1,346 nautical miles (1,548.97 miles)
- Crew: 11
- Armament: 10,000 pounds (9 metric tons) of ordnance including: Harpoon (AGM-84D) cruise missiles, SLAM (AGM-84E) missiles, Maverick (AGM 65) air-to-ground missiles, MK-46/50 torpedoes, rockets, mines, depth bombs, and special weapons
- Date Deployed: First flight, November 1959; Operational, P-3A August 1962 and P-3C August 1969

Table 1.   Additional Characteristics of the P-3C Orion. [From Ref. 4]

The EP-3E ARIES II is a modified P-3C with sophisticated electronic warfare and intelligence gathering capabilities. It is equipped with numerous receivers and high-gain dish antennas, which can detect tactically significant radar signals and electronic emissions. The aircraft shares the P-3C characteristics that are listed in Table 1. [From Refs. 6,7 and 8]

2.   In the Future

In the future, Maritime Patrol FRS pilots will train to fly military missions in the P-8 Multimission Maritime Aircraft (MMA). The P-8 MMA will be a modified Boeing 737-800ERX, with improved maritime surveillance and attack capabilities. It will be built upon a reliable airframe and will incorporate an upgraded radar and signal intelligence (SIGINT) system developed by Raytheon. The aircraft will be powered by two CFM International CFM56-7B27A high-bypass turbofan engines (which are rated at 120kN) and will have a maximum speed of 907km/h (563 mph).   Like the P-3, the P-8

will be capable of carrying a mixed payload of weapons internally and on wing pylons. Additional characteristics of the P-8 MMA are listed below in Table 2. [From Refs. 9,10,11 and 12]

- Wingspan with winglets: 35.81m
- Length: 38.56m
- Height: 12.83m
- Fuselage length: 38.02m
- Tailplane: 14.35m
- Maximum taxi weight: 83,778kg
- Maximum fuel capacity: 34,096kg
- Maximum zero fuel weight: 62,732kg
- CFM International CFM56-7B27A: 2
- Power: 2 x 120kN
- Maximum cruise altitude: 12,500m
- Maximum cruise speed: 907km/hr
- Economical cruise speed: 815km/hr
- Slow loiter speed at low altitude over sea: 333km/hr
- Demonstrated minimum altitude for tactical maneuvers: 61m
- Operating radius: 3,700km
- Landing run: <610m
- Rate descent: >3,048m/min

Table 2.   Additional Characteristics of the P-8 MMA. [From Ref. 9]

D.   FRS PILOT TRAINING CURRICULA

1.   Now

The pilot training curricula at VP-30 can take several different forms to reflect the training needs of students in seven different student pilot categories (Cat's). These seven categories are described below in Table 3.

Cat I – First tour Pilot /Patrol
Cat I (Non-AIP) – First tour Pilot/Non-Patrol (VQ)
Cat II – Pilots qualified in dissimilar military aircraft
Cat III – Second tour Pilot/Patrol
Cat III (Non-AIP) – Second tour Pilot/Non-Patrol (VQ)
Cat IV – Senior pilots qualified in dissimilar military aircraft
Cat V – Prospective Executive Officer/Commanding Officer (PCO/PXO)

Notes:
[1] "Cat" is an abbreviation for "Category".
[2] "AIP" stands for "Anti-Surface Warfare Improvement Program". P-3's with this designation "provide improvements in Command, Control, Communications, and Intelligence; surveillance and Over-the-Horizon Targeting capabilities; and survivability, to include the Maverick Missile System." [From Ref. 5] "Non-AIP" P-3's cannot provide these improvements.
[3] First tour pilots are newly winged naval aviators.
[4] Second tour pilots are senior Officers returning to the P-3 community.

Table 3.   VP-30 Student Pilot Category Descriptions. [From Refs. 13 and14]

The pilot training curricula for Cat I and III pilots are most applicable to this thesis research and will be described in this sub-section. The pilot training curriculum for Cat II pilots is identical to that of Cat I pilots. The pilot training curricula for Cat I and III non-AIP, Cat IV, and Cat V pilots are not applicable to this thesis research and will not be described. [From Ref. 13]

a.   The Cat I Pilot Training Curriculum

The Cat I pilot training curriculum is designed for newly winged Naval Aviators with no P-3 flight experience. It is 157 working days in length and is broken down into five different training phases. These phases incorporate numerous kinds of training, which are designed to help students progress towards proficiency as a P-3 co-pilot.

The primary type of training for VP-30's Cat I pilots is familiarization flight training. This type of training is conducted in an actual aircraft and is designed to give students practical experience flying the P-3. It is also designed to give students practical experience dealing with simulated emergencies and aircraft system malfunctions. Furthermore, familiarization flight training is used as a primary means of teaching takeoff, landing, and normal operating procedures. Seventy-five curriculum hours (ten flight events) are allocated for this portion of the training curriculum.

Secondary types of training are used in the VP-30 Cat I pilot training curriculum as well. These types of training include classroom lectures, cockpit procedural training, simulator training, weapons systems training, tactical aircrew training, tactical flight training, navigational flight training, and computer-based training (CBT).

Classroom lectures are mostly given in the early phases of Cat I pilot training. They are used to teach students about aircraft systems and operating procedures. They are also used to teach Crew Resource Management (CRM), instrument ground school, and aircraft emergency procedures. Lectures on aircraft systems are supplemented by three five-hour systems training events, which are conducted in a static Systems Trainer (ST). Lectures on normal and emergency operating procedures are supplemented by a single four-hour normal procedures simulator flight event.

Cockpit procedural training is also conducted in the early phases of the Cat I pilot training curriculum. It is taught in semi-functional cockpit mock-ups known as Cockpit Procedural Trainers (CPT's). These devices help students learn checklist procedures before they progress to advanced stages of Cat I pilot training curriculum. CPT's also help students become familiar with normal operating and emergency procedures. Forty-two curriculum hours (six pre-flight briefs and four CPT training events) are allocated for this portion of the training curriculum.

Simulator training is conducted in two different Link simulator models throughout many phases of the Cat I pilot training curriculum. It is used to supplement the flight training instruction that is given in the actual aircraft. Simulator training is also used to help pilots gain proficiency in executing normal and emergency flight procedures. Fifty-five curriculum hours (11 simulator flights) are allocated for this portion of the training curriculum.

Weapons systems training and tactical aircrew training are less intensive portions of the Cat I pilot training curriculum. Both employ fixed-base, non-motion, flight station simulators to teach students about P-3 mission profiles and tactical scenarios. Both are also used to teach pilots important aspects of aircrew coordination.

Five training events are conducted in Weapons Systems Trainers (WST's) and three training events are conducted in Tactical Aircrew Coordination Trainers (TACT's).

Tactical flight training is conducted in an actual aircraft. It is used to help students become familiar with the utilization of P-3 search and kill store systems. It is also used to introduce P-3 mission profiles and tactical scenarios. Finally, tactical flight training is used to teach students about Tactical Support Centers (TSC's), which are shore-based Naval Command and Control Centers. Twenty-three curriculum hours (four P-3 flight events) are allocated for this portion of the training curriculum.

Navigational flight training is also conducted in an actual aircraft. It is given in advanced phases of the pilot training curriculum to help students prepare for their instrument check-rides. It is also used to give students practical flight planning experience. Three flights (ten flight hours) are allocated for this portion of the training curriculum. However, these three flights are usually combined into one cross-country navigational flight event, commonly referred to as a Nav Extend.

Finally, computer-based training is a supplemental portion of the flight training curriculum. It is self-paced and includes lessons on a variety of aircraft subjects including the Electronic Flight Display System (EFDS) and the Control Display Navigational Unit (CDNU). Computer-based training also includes online quizzes, which students are expected to complete prior to their detachment from VP-30. [From Refs. 13 and 14]

b.   The Cat III Pilot Training Curriculum

The Cat III pilot training curriculum is designed to be a refresher for P-3 pilots who have spent time away from the Maritime Patrol Community. It is 90 working days in length and is broken down into three different training phases. These training phases incorporate most of the same pilot training methodologies and technologies that are used in the Cat I pilot training curriculum. However, they do not include as many actual flight training events. Cat III pilots are required to complete only two CPT events, five simulator flights, and six familiarization flights. In addition, Cat III pilots are not required to complete any navigational flight training. [From Ref. 15]

2. In the Future

It is unclear what Maritime Patrol pilot training curricula will look like in the future once a P-8 MMA FRS is established. This is because the Program Office in charge of designing the P-8 MMA training curricula is still conducting preliminary research on the effectiveness of different pilot training methods. Regardless, it appears that high technology simulators and flight training devices will be used in some capacity, because plans have already been made for their purchase. In addition, discussions have been made about the development of curricula, which rely primarily on the use of high technology simulators, rather than on actual Navy aircraft. [From Ref. 16]

E. FRS SIMULATOR USAGE

1. Now

VP-30 operates four Operational Flight Trainers (OFT's), which were manufactured by Link and upgraded by Rockwell Collins.[1] Three of these OFT's are motion capable within six degrees-of-freedom while the fourth has no motion capability at all. The motion capable simulators are very similar to Level C flight simulators but are not evaluated or assigned an actual flight simulator classification by the FAA.[2] They have significant visual and aerodynamic handling deficiencies (by today's standards) and are only capable of partially qualifying a VP-30 Cat I or Cat III pilot in the P-3C aircraft. The motion capable OFT's used by VP-30 are extremely reliable and are contracted to operate between 16-18 hours a day.[3] [From Ref. 18 and19]

VP-30 also operates two non-visual CPT's, two Weapons Systems Trainers (WST's), 1 Tactical Aircrew Coordination Trainer (TACT), and 3 Hulk trainers.[4] These

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[1] The OFT's, CPT's, WST's, and Hulk trainers along with the lone TACT trainer used by VP-30 are owned by CPRW-11 and are shared by many P-3 squadrons at NAS Jacksonville. [From Ref. 18]

[2] "Level C" flight simulators are able to meet all of the Level C flight simulator standards set forth by the Federal Aviation Administration (FAA). These standards, which are described in Appendix A, require an advanced visual display and a motion system with at least six degrees-of-freedom. Currently, there are four major simulator classifications (A, B, C, and D) assigned by the FAA. "Level C" is the second highest of these classifications. [From Appendix A and Ref. 17]

[3] The reliability of the flight simulators used by VP-30 is measured in terms of trainer availability against contracted flight time. Over the past five years, the average monthly availability rate of the P-3 flight simulators used by VP-30 personnel has exceeded 99 percent. [From Ref. 18]

[4] Hulk trainers are static cockpit displays, which are used by students for cockpit familiarization and procedural practice purposes. They are not used in any training curricula and exist solely for student use during independent study.

training devices have also not been evaluated or assigned a flight simulator classification by the FAA but are effective in partially training P-3 pilot crewmembers.

2. In the Future

The MMA Program Office in Patuxent River, MD has made plans to purchase two Level D Operational Flight Trainers for use in the P-8 FRS.[5] However, it is still unclear to what extent these simulators will be used to train future Maritime Patrol pilots. The MMA Program Office has also made plans to purchase two Weapons Tactics Trainers (WTT's), two Tactical Operational Flight Trainers (TOFT's), a Part Task Trainer (PTT), and an Integrated Avionics Trainer (IAT). Each of these training devices will be used to train P-8 pilot crewmembers. [From Ref. 16]

F. FLIGHT TRAINING INSTRUCTORS

1. Now

The flight training instructors at the P-3 FRS are active duty and reserve Naval Aviators with hundreds (and often more than a thousand) hours of flight time in the P-3 aircraft. Most have been on at least one overseas deployment and have over seven years of flight experience with the U.S. Navy. All are accomplished airmen who have earned the distinction of P-3 Patrol Plane Commander (PPC).[6] In addition, all have undergone a rigorous Instructor Under Training (IUT) training curriculum to help prepare them for instructional flight time with FRS students. Approximately 61 flight training instructors are employed at VP-30. [From Ref. 3 and 14]

2. In the Future

It is still unclear what kind of flight training instructors the Maritime Patrol Community will use in the future, once a P-8 MMA FRS is established. If flight training curricula based primarily on the use of aircraft are implemented into the P-8 FRS, the Navy may decide to continue using active duty and reserve Naval Aviators as flight instructors. However, if flight training curricula based primarily on the use of simulators

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[5] "Level D" flight simulators are able to meet all of the Level D flight simulator standards set forth by the Federal Aviation Administration (FAA). These standards, which are described in Appendix A, require a state-of-the-art visual display and a "buffet-capable" motion system with at least six degrees-of-freedom. Currently, there are four major simulator classifications (A,B,C, and D) assigned by the FAA. "Level D" is the highest of these classifications. [From Appendix A and Ref. 17]

[6] Patrol Plane Commander (PPC) is a title given to the first pilot of a P-3 aircraft. This individual is responsible for all matters pertaining to the safety of flight. The PPC is also responsible for coordinating tactical information with other crewmembers to effectively accomplish an anti-submarine warfare (ASW) mission. [From Ref. 20]

are implemented into the P-8 FRS, a greater opportunity will exist to employ different kinds of flight training instructors such as experts from companies like Boeing or FlightSafety International.[7] Implementing curricula based primarily upon the use of simulators would also mean that fewer flight training instructors would be needed overall. This could result in significant cost savings for the Navy and the Maritime Patrol Community.

G.   BACKGROUND OF STUDENT PILOTS

CAT I pilots at VP-30 are graduates of Navy flight schools and are very well trained in the field of aviation. However, these pilots are also very inexperienced. Most arrive at VP-30 with very little flight time (usually between 250 and 350 hours) and very few flight credentials. In addition, most have only flown two different types of aircraft and have not spent much time as a Pilot in Command.

CAT III pilots at VP-30 are older, more experienced Naval Aviators who have recently been away from the Maritime Patrol Community. They have accumulated hundreds of hours (and usually over a thousand hours) of flight time in the P-3 aircraft and have been on at least one operational deployment in the P-3. Most have served as a P-3 Mission Commander or Patrol Plane Commander and built impressive flight credentials. In addition, some have served as flight instructors of other naval aircraft such as the T-34 Turbomentor, the T-44 Pegasus, and the C-12 Huron.

H.   P-3/EP-3 MISHAP INFORMATION

Pilot mishap information can often provide useful insights into the effectiveness of an organization's pilot training methodologies and technologies. For this reason, the following information is provided.

From 30 January 1963 through 10 July 2003, there were 50 U.S. Navy P-3 or EP-3 Class A and major Class B mishaps.[8] At least 28 of these mishaps were a result of aircrew error. Together, the 50 mishaps have resulted in the deaths of 248 aircrew members and the destruction of 38 P-3 and EP-3 aircraft.

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[7] "FlightSafety International is the world's largest provider of aviation services, training over 65,000 pilots annually at 42 Learning Centers in the U.S., Canada, France, and the U.K." [From Ref. 21]

[8] A Class A mishap is an accident that results in fatality, permanent total disability, or $1 million or more of total property damage. A Class B mishap is an accident that results in permanent partial disability, $200,000 or more but less than $1 million of total property damage, or three or more personnel hospitalized as inpatients. [From Ref. 22]

While the number of P-3 and EP-3 mishaps over the last 40+ years may seem high, it is important to note that the rate of these mishaps has decreased in recent history. In the first 20-year period that P-3 and EP-3 flight safety information was collected (30 January 1963 – 30 January 1983), there were 39 recorded mishaps. Over the next 20-year period (30 January 1983 – 30 January 2003) there were only ten. The most recent mishap occurred on 10 July 2003. [From Ref. 23]

III. AIRLINE PILOT TRAINING (THE CASE OF JETBLUE AIRWAYS)

A.   PURPOSE OF CHAPTER

This chapter is intended to give the reader an understanding of how pilot training is conducted in the commercial airline industry. JetBlue Airways was studied because the pilot training methodologies and technologies employed there are representative of what is seen throughout most of the airline industry. A thorough understanding of these methodologies and technologies is important because they are more cost-effective than the ones being employed at VP-30. In addition, the Navy may want to consider implementing the curricula that employ these training practices into the P-8 MMA FRS once it is established. Chapter IV discusses some of the potential, future cost savings associated with this training policy option.

B.   JETBLUE AIRWAYS CORPORATION

JetBlue Airways Corp. is a low-fare U.S. airline that is based out of John F. Kennedy International Airport (JFK) in New York City. The company provides air transportation services to over 30 locations throughout the United States and the Caribbean. These services are provided through the operation of 77 Airbus A320 aircraft, which fly over 275 flights per day. [From Refs. 24 and 25]

C.   PILOT TRAINING AT JETBLUE AIRWAYS

The pilot training process at JetBlue Airways has been designed to be cost effective and to "…ensure the highest level of professional performance. All training facilities, assets, programs, and reference materials are specifically directed toward providing a training climate that will produce and foster technical expertise, facilitate the development of specific skills, and promote the accrual of professional knowledge." [From Ref. 26] The pilot training process at JetBlue has also been designed to reflect the company's core training philosophies.   These philosophies include a "Systematic Approach to Instruction", a "Learning by Doing" mentality, and a "Training to Proficiency" instructional standard.

Under the "Systematic Approach to Instruction" philosophy, the methodologies and means for training are selected based upon their ability to achieve certain learning

objectives. These objectives are determined through task analysis and are fulfilled through the incorporation of training modules. In addition, instructional training is evaluated as a whole in terms of its ability to meet and achieve the predetermined training objectives.

Under the "Learning by Doing" mentality, training modules and lessons build upon one another as students progress through the training curriculum. Systems and procedural instruction are integrated simultaneously, and pilots are required to progress toward full flight proficiency. Practical exercises in the training modules assist in this process.

Finally, under the "Training to Proficiency" philosophy at JetBlue, student pilots must demonstrate a certain level of competence and proficiency before being allowed to progress to advanced stages of the pilot training curriculum. Students unable to demonstrate a predetermined level of proficiency at the completion of a training session are required to repeat that course of instruction. [From Ref. 27]

D.   AIRCRAFT-SPECIFIC TRAINING

Student pilots at JetBlue Airways are trained to fly commercial passenger routes in the Airbus A320 aircraft. The Airbus A320 is a multi-engine short to medium range airliner manufactured by Airbus. It is powered by two International Aero Engines (IAE) V2500 engines and incorporates a state-of-the-art, fly-by-wire flight control system. The Airbus A320 has a maximum speed of approximately 870km/h (541 mph) and a range of approximately 2900 nautical miles (3,350 miles) when fully loaded. [From Ref. 28] Additional characteristics of the Airbus A320 are listed below in Table 4.

- Crew: 2 pilots, 4 flight attendants
- Capacity: 150 passengers
  - Freight: 16 300 kg (35 900 lb)
- Length: 37.57 m (123 ft 3 in)
- Wingspan: 34.09 m (111 ft 10 in)
- Height: 11.76 m (38 ft 7 in)
- Wing area: 122.6 m²
- Maximum takeoff: 73 500 kg (162 000 lb) / 77 000 kg (169 800 lb)
- Powerplant: 2 x CFM56-5 111 kN
- Powerplant: IAE V2500 120 kN
- Maximum landing: 64 500 kg (142 200 lb) / 66 000 kg (145 500 lb)
- Maximum cabin width: 3.70 m (12 ft 1 in)
- Wing sweep (25% chord): 25°
- Wheel track: 7.59 m
- Maximum ramp weight: 73 900 kg / 77 400 kg
- Maximum zero fuel weight: 61 000 kg / 62 500 kg
- Maximum fuel capacity: 23 860 L / 29 660 L
- Typical operating weight, empty: 42 400 kg
- Typical volumetric payload: 16 300 kg
- Bulk hold volume: 37.43 m³

Table 4.   Additional Characteristics of the Airbus A320 Aircraft. [From Ref. 28]

E.   JETBLUE PILOT TRAINING CURRICULA

The pilot training curricula at JetBlue Airways can take several forms to reflect the category of training being given. The training categories for an Airbus A320 pilot include "Initial New Hire Training", "Upgrade Training", "Recurrent Training", and "Requalification Training". This section will examine the training curricula for each of these training categories.

1.   Initial New Hire Training

Newly hired pilots at JetBlue Airways are required to complete a 6-week, flight-training curriculum before being cleared to fly commercial passenger routes. This training curriculum is very cost effective and does not include many flight hours in an actual Airbus aircraft. Instead, the curriculum relies primarily on flight time in JetBlue's high technology, full-motion simulators, which are realistic and capable of simulating nearly every kind of aircraft system malfunction. These simulators will be described in the next section of this thesis.

The flight training curriculum for newly hired Airbus A320 pilots consists of other types of training as well, such as Emergency Training, Ground Training, subject matter training, Flight Operations Line Training, Initial Qualification Training and computer based training. These types of training, with the exception of computer based training, are listed in Appendix B (JetBlue A320 Pilot PIC/SIC Initial New Hire Training Plan (IN)) along with the number of curriculum hours allocated for each.

Emergency Training is given in a classroom setting and also through the use of emergency exit door trainers. It serves to familiarize pilots and crewmembers with their emergency duties and responsibilities. It also serves to familiarize pilots with the location, function, operation, and employment of the emergency equipment on the Airbus A320 aircraft.

Ground Training is taught mostly in a classroom setting by qualified JetBlue employees. It includes 21 hours of systems instruction in addition to other aircraft specific and flight management related topics. Ground Training is also taught in Flight Training Devices (FTD's), which are semi-functional cockpit mockups similar to the Cockpit Procedural Trainers (CPT's) used in Naval Aviation. FTD's are used by JetBlue to teach students checklist procedures before they enter the full flight-simulator phase of training. FTD's are also used to teach various aspects of Airbus automation.

Subject matter training is also taught in a classroom setting by JetBlue instructors along with subject matter experts. These subject matter topics include Basic Indoctrination, Security Training, Initial Dangerous Goods/Hazmat Training, Cockpit Resource Management (CRM), and Special Subjects Training. The Federal Aviation Administration (FAA) requires instruction on many of these subject matters.

Flight Operations Line Training is best described as "a day in the life" training. It is designed to give pilots a better understanding of the general flight operations that pertain to them. Significant time is spent on base orientation and flight control issues.

Initial Qualification Training is the only portion of the Airbus A320 pilot training curriculum that involves actual flight training in an aircraft. However, this flight training is not traditional flight training. Instead, it is initial airline flight experience with paying customers on board. New trainees are matched up with senior Instructor Pilots (IP's)

only to ensure operations proceed smoothly during a pilot's first few flights in the actual aircraft. Twenty-five hours of Initial Qualification Training are required by the FAA.

Finally, computer based training is a form of instruction that is given to supplement the training curriculum. Student pilots are given laptop computers and are required to complete lessons on various subjects in their free time. Many of these lessons are given prior to simulator flights. [From Refs. 26 and 29]

2. Upgrade Pilot Training

Airbus A320 pilots at JetBlue wishing to upgrade from First Officer to Captain must complete an advanced flight training curriculum. This curriculum is similar to the curriculum for new hires because it relies primarily on the use of the company's high technology simulators. Thirty-seven hours are flown in these simulators to allow pilots to gain more flight experience, particularly in dealing with aircraft malfunctions. They are also flown to help First Officers become proficient in flying from the cockpit's left seat, which is the seat designated for aircraft Captains.

The upgrade training curriculum is also similar to the new hires' curriculum because it includes classroom instruction, Ground and Emergency Training, and operating experience in the actual aircraft. The classroom instruction focuses on aircraft systems and other important subject matter and does not include any new material. Rather, it is designed to be a "refresher" for pilots who have already completed Initial New Hire Training and have gained practical experience flying as a JetBlue First Officer. [From Refs. 26 and 29]

Appendix B (JetBlue A320 Pilot (PIC/SIC) Upgrade Training Plan (U)) summarizes the entire JetBlue, Airbus A320, pilot training curriculum for upgrading pilots and shows the amount of time allocated for each training segment.

3. Recurrent Training

Qualified Airbus A320 Captains and First Officers at JetBlue are periodically required to complete a Recurrent Training curriculum as set forth in section 121.433 of the Federal Aviation Regulations (FAR) handbook. This curriculum, like the previous

two, includes Systems Training, Ground Training, Emergency Training, and subject matter training. It also includes Proficiency Training or a Proficiency Check, a Line Check, and an Emergency Drill.

Proficiency Checks and Proficiency Training are substitutes of one another in the recurrent pilot training curriculum. These forms of training are designed to alternate with one another from one Recurrent Training phase to the next. The exception to this rule is during the first year as a Captain and the first two years as a JetBlue First Officer. During this time period, two Proficiency Checks are given in succession (one during each Recurrent Training phase).

Both Proficiency Checks and Proficiency Training are given to pilots in JetBlue's high-technology flight simulators. Proficiency Checks are more formal training events and are conducted by FAA certified Designated Examiners. Proficiency Training flights are less formal events that give pilots a chance to ask questions and interact with JetBlue simulator instructors.

The Line Check and Recurrent Emergency Drill are less intensive portions of the Recurrent Training curriculum. The Line Check consists of flying an actual airline revenue flight with a JetBlue Company Check Airman, who observes flight operations in the cockpit. The Emergency Drill involves practicing emergency procedures in a fuselage mock-up. It is similar to the Emergency Training conducted in other JetBlue pilot training curricula. [From Refs. 26 and 29]

Appendix B (JetBlue A320 Pilot (PIC/SIC) Recurrent Training Plan (RT)) summarizes the entire JetBlue, Airbus A320, pilot training curriculum for recurrent pilots. It shows the amount of time allocated for each training segment in addition to the number of months between each required phase of training.

4. Requalification Training

JetBlue pilots seeking to re-establish flight currency or re-qualify for flight in an Airbus A320 aircraft are required to complete the Requalification Training curriculum. The nature of this training curriculum can vary depending upon what currencies and qualifications have been lost by a particular pilot. However, none of the curriculum

variants contain material or forms of instruction that are different from what a pilot has already received from JetBlue in previous training. [From Refs. 26 and 29]

Appendix B (JetBlue A320 Pilot (PIC/SIC) Requalification Training Plan (RL/RQ)) lists the different Requalification Training curriculum variants. It also summarizes the number of training hours allocated for the training segments within each variant.

F.   JETBLUE'S AIRBUS A320 FLIGHT SIMULATORS

JetBlue Airways owns and operates four Airbus A320 simulators, which were manufactured by CAE Corporation in Montreal, Canada. These simulators are full motion, Qualified Level D training devices that represent the latest advances in simulator technology. They have the capability of qualifying a JetBlue Captain or First Officer as an Airbus A320 crewmember without any actual time in an A320 aircraft. They also have a reliability rate {calculated as %Reliability = ((Scheduled Time – Down Time)/Scheduled Time x 100)} which is usually in the high 90's.[9]

JetBlue Airways also owns and operates three Airbus A320 Flight Training Devices (FTD's), which were manufactured by CAE. These simulators are Qualified Level 5 training devices that have the capability to partially train JetBlue Captains and First Officers.[10] The reliability for these devices is also usually in the high 90's.[11] [From Refs. 30 and 31]

G.   JETBLUE'S FLIGHT TRAINING INSTRUCTORS

Similar to most airline companies, the simulator instructors at JetBlue are retired airline pilots. Some are Line Flight Officers who have been screened and temporarily assigned. Others (as previously mentioned) are Check Airmen and FAA designees.

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[9] The average reliability rate for JetBlue's four Airbus A320 simulators during January, 2006 was 98.74 percent. The total number of utilization and downtime hours for these four simulators during that month was 1608 and 20.51 respectively. [From Ref. 31]

[10] "Level 5" flight training devices are able to meet all of the Level 5 flight training device standards set forth by the Federal Aviation Administration (FAA). These standards "permit the learning, development, and practice of skills, cockpit procedures, and instrument flight procedures necessary for understanding and operating the integrated systems of a specific aircraft in typical flight operations in real time." Currently, there are seven major flight training device classifications (Levels 1 through 7) assigned by the FAA. "Level 5" is the fifth highest classification. [From Ref. 17]

[11] The average reliability rate for two of JetBlue's Airbus A320 FTD's during January, 2006 was 99.97 percent. The total number of utilization and downtime hours for these two FTD's during that month was 492 and .17 respectively. Reliability, utilization and downtime information on JetBlue's third FTD, for January, 2006, was not available at the time of this study. [From Ref. 31]

Most Ground school and subject matter instructors at JetBlue are retired airline pilots as well.

New Line Flight Officers typically earn around $65,000 annually. New Check Airman and FAA designees typically earn around $75,000 annually. Both receive an average annual increase of 3%. [From Ref. 31]

H.   BACKGROUND OF JETBLUE STUDENT PILOTS

Most student pilots at JetBlue seeking to become First Officers are very experienced in the field of aviation. They have often logged thousands of hours of flight time and become proficient in the operation of numerous military and civilian aircraft. Most have also obtained flight credentials and qualifications that meet or exceed the basic requirements for a JetBlue First Officer. These minimum flight qualifications are listed below in Table 5.

- 1500 hours total pilot time in airplanes (excluded: Helicopter, Simulator, Flight Engineer time)
- 1000 hours of turbine time in an airplane
- 1000 hours Pilot in Command Time
- 1000 hours in airplanes at or above 20,000 pounds (maximum takeoff weight) or 1000 hours in large turbojet airplanes (12,500 lbs or above)
- Recency of flight experience will be considered
- Federal Aviation Administration (FAA) Airline Transport Pilot (ATP) Certification
- Current FAA Class 1 Medical Certificate
- Federal Communication Commission (FCC) Radio License
- Three reference letters from pilots who can personally attest to the candidate's flying skills (must bring originals to interview)

Table 5.   Minimum Flight Qualifications for a JetBlue First Officer. [From Ref. 24]

In addition to meeting the minimum First Officer flight qualifications, most student pilots at JetBlue also meet the competitive flight qualifications for a JetBlue First Officer. These competitive qualifications are listed below in Table 6.

- Between 3,000 and 10,000 hours total pilot time in airplanes
- Greater than 2,000 hours turbine PIC in jets
- Greater than 2,000 hours in airplanes at or above 20,000 pounds (maximum takeoff weight)
- Experience with more sophisticated aircraft utilizing Electronic Flight Instrument Systems (EFIS), Flight Management Systems (FMS)

Table 6.   Competitive Qualifications for a JetBlue First Officer. [From Ref. 24]

I.   JETBLUE PILOT MISHAP INFORMATION

Over its brief history JetBlue Airways has built a reputation for leadership in airline flight safety. Since the company's inaugural flight in February 2000, only one flight incident has been reported to the National Transportation Safety Board (NTSB) (as of 7 October 2005). This low incident rate may indicate the effectiveness of the pilot training methodologies and technologies being used at JetBlue. [From Refs. 24 and 32]

J.   THE SUPERIORITY OF AIRLINE PILOT TRAINING

From previous sections of this thesis, one can ascertain that great dissimilarities currently exist in the way commercial airline companies (including JetBlue Airways) and VP-30 train their student pilots. The biggest dissimilarity is the fact that these organizations require students to complete training curricula that employ entirely different primary training methodologies and technologies. VP-30's pilot training curricula rely primarily on the use of actual aircraft whereas commercial airline pilot training curricula rely primarily on high technology Level D flight simulators. These simulators are so advanced that they eliminate the need for secondary training in an actual aircraft.

Relying on Level D flight simulators for flight training allows commercial airline companies to operate much more cost-effectively than VP-30. This is because simulator-based curricula require far fewer administrative, maintenance, and training personnel than aircraft-based curricula. They also eliminate the need for some expensive training facilities (such as aircraft hangars) and allow for shorter overall training times. Simulators themselves are cheaper to maintain than P-3 aircraft and do not require aviation fuel.

Since a reliance on Level D flight simulators for flight training has allowed commercial airline companies to operate more cost-effectively than VP-30, considerations are being made to implement Level D-simulator-based training curricula into the future P-8 MMA FRS. Chapter IV discusses some of the potential, future cost savings associated with this training policy option.

IV. POTENTIAL COST SAVINGS ANALYSIS AND METHODOLOGIES

A. PURPOSE OF CHAPTER

This chapter discusses and, where possible, provides estimates of the potential cost savings associated with implementing airline pilot training curricula into the future P-8 MMA FRS. Cost savings estimations are made by comparing the theoretical costs associated with the implementation of airline pilot training curricula to the actual costs that are expected to accrue once the FRS is established. Cost savings estimations cannot be made in some areas because important information related to the training plans and structure of the future FRS is unavailable or could not be collected in the timeframe of this research study. Estimations cannot be made in other areas because more research into the nature of spending in particular cost areas needs to be conducted. In sections where cost savings estimations cannot be made, an approach for estimating future FRS cost savings is provided.

B. P-3 FRS OPERATIONAL COST DATA

Appendix C provides categorical cost figures for operations at VP-30 over eight successive fiscal years (fiscal years 1997-2004). These cost figures were reported by the Navy Visibility and Management of Operating and Support Costs (VAMOSC) management information system and will be taken into account in some future cost analysis discussions.[12] All of the costs in Appendix C are reported in constant fiscal year (FY) 2006 dollars. A brief description of each P-3 FRS cost category reported by VAMOSC in Appendix C is listed below.[13] Section C discusses and, when possible, estimates the potential cost savings that might accrue in some of these same cost areas if airline pilot training curricula are implemented into the future P-8 FRS. In instances where cost savings estimations cannot be made, an approach for estimating future FRS costs savings is provided.

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[12] VAMOSC is a web-enabled management information system that collects and reports historical Navy and Marine Corps Operating and Support (O&S) costs on an annual basis. [From Ref. 33]

[13] The VAMOSC cost category descriptions in section B are either derivations of the categorical element definitions found in the VAMOSC Aviation Type/Model/Series Reporting Users Manual or exact reproductions of the definitions themselves. See Reference 34.

1. **Org. FRS-MilPers Costs-Navy-Mission -** This element reports the total pay costs of Navy personnel who are assigned as mission personnel (pilots and crew) at the P-3 FRS in Jacksonville, FL. Total pay includes base pay, allowances, entitlements, and bonus/incentives. Included also within this element are the other payroll costs of retirement accrual and the Federal Insurance Contributions Act (FICA).

2. **Org. FRS-MilPers Costs-Navy-Maintenance -** This element reports the composite pay of Navy personnel assigned as maintenance personnel.

3. **Org. FRS-MilPers Costs-Navy-Other -** This element reports the composite pay of Navy personnel assigned to perform duties other than those assigned for mission and maintenance personnel.

4. **FRS Fuel Costs -** This element reports the cost of aviation propulsion fuel purchased by the Navy to support flight operations of Navy aircraft. This cost element does not include the costs for petroleum, oil, and lubricants (POL) used in organizational aircraft maintenance.

5. **FRS Support Supplies Costs -** This element reports organizational level expenditures by the Navy since it cannot be included within other specific Aviation Type/Model/Series Reporting (ATMSR) categories. Reported are organizational maintenance materials, flight clothing, safety equipment, and administrative supplies.

6. **FRS AVDLR Costs Total -** This element summarizes the costs for the retail purchase of repairable components from both the Navy supply system and from commercial sources. There are two major components to this element: Organic Aviation Depot Level Repairables (AVDLR) Costs and Commercial Repair of Repairables (RoR) Costs.

7. **FRS Training Expendable Stores Costs -** This element reports the costs of non-nuclear conventional ammunition expended by P-3 FRS aircraft. Ammunition includes conventional air ammunitions, missiles, torpedoes, mines, and sonobuoys. A redesign of this cost element and its processing in FY 2000 added air launched torpedoes (4T COG) and mines (8T COG).

8. FRS Temporary Additional Duty Costs - This element reports the costs of temporary additional duty (TAD) by Navy and civilian personnel assigned to the FRS. TAD includes travel and per diem costs for training and other administrative purposes. Included in these costs are commercial transportation charges, car rental, mileage allowance, and subsistence.

9. Simulator Operations - This element reports the costs incurred to provide, operate, and maintain on-site or centralized simulator training devices for aircraft systems, subsystems, and related equipment. This includes the labor, material, and overhead costs of simulator operations by military and civilian personnel and private contractors.

10. FRS PCS Costs - This element reports the cost of Permanent Change of Station (PCS) movements of Navy personnel to support VP-30.

C. POTENTIAL COST SAVINGS

This section will discuss and estimate (when possible) the cost savings that might accrue in some of the main FRS cost areas described above if airline pilot training curricula are implemented into the future P-8 FRS. In sections where cost savings estimations cannot be made, an approach for estimating future FRS costs savings is provided.

1. Military Personnel Costs – Mission

If airline pilot training curricula were implemented into the future P-8 FRS and the Navy Maritime Patrol Community decided to outsource its FRS flight training instruction, military mission personnel cost savings would accrue. This is because contracted employees from an organization like Boeing or FlightSafety International would replace all of the Instructor Pilots (IP's), Instructor Naval Flight Officers (INFO's) and enlisted aircrew instructors employed at the FRS. Flight training instruction costs would no longer accrue in the "Org. FRS-MilPers Costs-Navy-Mission" cost category because they would be included in the total cost of an outsourced flight training contract.

If airline pilot training curricula were implemented into the future P-8 MMA FRS and the Navy did not decide to outsource its FRS flight training instruction, it is unclear whether military mission personnel cost savings would accrue. This is because it is

unclear whether fewer military Instructor Pilots (IP's), Instructor Naval Flight Officers (INFO's) and aircrew instructors would be needed to support a set of simulator-based training curricula. Whether or not fewer military instructors would be needed to support a set of simulator-based training curricula would depend on many things, including the number of simulators acquired for use at the FRS, the hours of operation for the simulators, and the numbers of hours FRS instructor pilots would be allowed to instruct in a simulator each day. It would also depend on the number of students at the FRS and the FRS training OPTEMPO (this could vary with the demand for FRS student graduates). Potential cost savings estimations in this area are difficult to make without this kind of information.

This section will not attempt to estimate the potential military mission personnel cost savings associated with implementing airline pilot training curricula (with or without flight instruction outsourcing) into the future P-8 MMA FRS. This is because it is unclear how many instructors will be employed at the future training squadron to support the set of curricula that is implemented. Regardless, it is noted that since all instructor positions at the FRS could be eliminated with airline pilot training curricula and flight instruction outsourcing, every position that does exist will represent potential military personnel mission cost savings. It is also noted that the Navy MPN and RPN programming rates might be helpful in estimating the potential cost savings associated with each instructor position in a future year.[14] It is believed that FY 2013 is the earliest that the P-8 FRS could be established, but programming rates for that year have not yet been established. [From Ref. 35] Programming rates for FY 2011 have been established and are listed below in Table 7 for informational purposes.

Programming Category	Officer	Enlisted Service Member
MPN	$132,040	$63,650
RPN	$154,527	$68,623

Table 7.   FY 2011 MPN and RPN Programming Rates [From Ref. 36].

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[14] MPN is an abbreviation for Manpower, Personnel Navy. RPN is an abbreviation for Reserve Personnel Navy.

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2. Military Personnel Costs – Maintenance

If airline pilot training curricula were implemented into the future P-8 FRS military maintenance personnel cost savings would accrue (regardless of whether flight training instruction was outsourced or not). This is because no maintenance personnel are needed to support flight training curricula that do not use aircraft. As with military mission personnel, all of the military maintenance personnel costs that accrue in the future would represent potential cost savings.

To estimate the potential military maintenance personnel cost savings at the future P-8 FRS one must know how many of each type of maintenance personnel the Navy plans to employ at the FRS. This information is currently unknown. However, it is expected that fewer maintenance personnel will be employed at the P-8 FRS since fewer aircraft are expected to be flown there than are currently at VP-30 today.[15] As with military mission personnel, the MPN and RPN programming rates might be helpful in estimating the potential cost savings associated with each FRS maintenance position in a future year.

3. Military Personnel Costs – Other

If airline pilot training curricula were implemented into the future P-8 MMA FRS and the Navy Maritime Patrol Community decided to outsource FRS flight training operations, other military personnel cost savings would accrue. This is because most of the non-mission and non-maintenance (other) FRS employees would be replaced by contracted employees from an organization like Boeing or Flight Safety International. A large number of the FRS employees replaced by contract employees would be administration clerks, yeomen and squadron safety personnel. Flight training instruction costs would no longer accrue in the "Org. FRS-MilPers Costs-Navy-Other" cost category because they would be included in the total cost of an outsourced flight training contract.

If airline pilot training curricula are implemented into the future P-8 MMA FRS but the Navy Maritime Patrol Community did not decide to outsource its FRS flight training, it is unclear whether other military personnel cost savings would accrue. This is because it is not known how many non-mission, non-maintenance personnel will be employed at the future training squadron to support the set of curricula that is

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[15] VP-30 currently owns and operates more than 30 aircraft. [From Ref. 2]

implemented. Whether or not fewer non-mission, non-maintenance personnel would be needed to support a set of simulator-based training curricula would depend on many things including the number of students stationed at the FRS (this would affect the number of administrative personnel needed at the squadron) and the extent to which these kinds of curricula require administrative support.

This section will not attempt to estimate the military personnel other cost savings that would accrue if airline pilot training curricula were implemented into the future P-8 FRS (with or without outsourcing). Regardless, it will be noted that since many non-mission, non-maintenance positions at the FRS could be eliminated with airline pilot training curricula and flight instruction outsourcing, every position that could potentially be eliminated would represent potential military personnel other cost savings. In addition, it will once again be noted that the MPN and RPN programming rates might be helpful in estimating the potential cost savings associated with positions that could be eliminated in a future year.

4. Fuel Costs

Another area where significant cost savings might accrue if airline pilot training curricula were implemented into the future P-8 FRS is annual fuel costs. Over the eight-year time period detailed in Appendix C (FY 1997-2004), VP-30 spent a total of $62,691,337 on aviation fuel (an average of $7,836,417 per year). This equates to approximately $826 per operation flight hour ($62,691,337 total fuel costs / 75,857 total flight hours). A fleet of between 22 and 30 aircraft was maintained and operated during that time span.

Regardless of whether airline pilot training curricula are implemented into the P-8 MMA FRS, future FRS fuel costs may be significantly lower than they are today. This is because the Navy will almost certainly choose to acquire fewer aircraft for use at the P-8 FRS than VP-30 owns today.[16] Fewer FRS aircraft may result in fewer flight hours and fuel cost expenditures if potential flight hour decreases are not offset by extended aircraft operating times. Fuel cost expenditures could also decrease significantly if the average

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[16] The high costs associated with the purchase of MMA aircraft will likely mandate this course of action.

fuel consumption rate of the P-8 MMA aircraft is lower than that of the P-3C Orion (4000-5000 lb/hr).[17] [From Ref. 4]

While future fuel cost savings might result regardless of the pilot training curricula that are implemented at the P-8 FRS, a decision to fully implement airline pilot training curricula would maximize the squadron's fuel savings potential. It would also help protect the Maritime Patrol Community from the financial uncertainties related to the rising price of oil (fuel). This is no small matter when one considers the magnitude of recent fuel price increases.[18] It is also no small matter when one considers that environmental and political events in the world today can cause sudden disruptions in the nation's fuel supply triggering rapid fuel price increases. This was seen in the summer of 2005 when Hurricane Katrina ripped through the Gulf of Mexico region, severely damaging oil platforms and refineries.

It is extremely difficult to estimate the potential fuel cost savings associated with implementing airline pilot training curricula into the future P-8 FRS. This is because the training structure of the FRS has not been established, and the extent to which actual aircraft will be used for flight training is not known. Still, fuel cost savings estimates can be made if hypothetical assumptions about the nature of training at the future FRS are made. For the purposes of this study, it will be assumed that P-8 FRS aircraft will be used 50 percent less than they would be if traditional pilot training curricula were implemented.[19] It will also be assumed that this 50 percent decrease in aircraft flight training will be made up for in Level D flight simulators.

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[17] The average fuel consumption rate of 737 models flown in the commercial airline industry is proprietary information that could not be collected. However, it was learned that the average fuel consumption rate of the 737's being flown at the 201st Airlift Squadron at Andrews, AFB is 5000 lb/hr.

[18] Between FY 2005 and FY 2006 the price of JP-5 aviation fuel increased by 9.6 percent or $5.46 /barrel.

[19] Traditional pilot training curricula are used today at VP-30.

The first step is to make some key cost factor estimations. Fuel cost factors which must be estimated include the number of FRS flight hours in a future fiscal year, the cost of JP-5 for the same fiscal year, and the fuel consumption rate of the P-8 MMA aircraft (See Table 8 below).[20]

FRS Flight Hours in FY 2014	5,572 [21]
The Cost of JP-5	$78.48 /barrel [22]
Fuel Consumption Rate of the P-8 MMA	5000 lb/hr [23]

Table 8.   FY 2014 Fuel Cost Factor Estimations.

By taking into account the fuel factor estimations described above, the total fuel cost savings in FY 2011, would be roughly $7.6M. The calculations below detail how this figure was derived.

(5000 lb/hr Fuel Consumption Rate) x (5,572 Scheduled Flight Hours) = 27,860,000 lbs JP-5 required

(27,860,000 lbs JP-5 required) ÷ (286.44 lb/barrel of JP-5) = 97,262.95 barrels of JP-5 required

(97,262.95 barrels of JP-5 required) x ($78.48/barrel of JP-5) = $7,633,196 in fuel cost savings or roughly $7,600,000.

The final step in roughly estimating the fuel cost savings is to decrease the fuel cost savings figure previously calculated by 50 percent. This 50 percent order of magnitude decrease is necessary to satisfy our hypothetical assumption that actual aircraft

[20] This section will assume the P-8 MMA FRS will be in existence and fully functional in FY 2013 and FY 2014. This section will also assume the JP-5 aviation fuel consumed by FRS aircraft in FY 2014 will be purchased at this study's estimated FY 2014 price ($69.77 per barrel).

[21] This estimate is based upon the 9.5 percent average annual decrease in Maritime Patrol FRS flight hours over the past two fiscal years (FY 2004 and 2005). [From Appendix C and Ref. 37] This figure assumes the 9.5 percent average annual decrease will continue for three additional years before leveling off in FY 2008. Decreases in FRS flight hours might occur in the near future as BAMS UAV's offload more P-3 and P-8 fleet missions. Fewer P-3 and P-8 fleet missions may result in fewer student pilots being ordered to the FRS and fewer flight hours being flown there on an annual basis. [From Ref. 35]

[22] This is an estimate of the price of JP-5 in FY 2014. It assumes a four percent annual price increase from the FY 2007 price of $59.64 per barrel.

[23] This estimate of the P-8 MMA's average fuel consumption rate based upon the average fuel consumption rate of 737's flown by the 201st Airlift Squadron at Andrews AFB.

will be used 50 percent less in the P-8 FRS than they would be if traditional pilot training curricula were implemented. When we take into account this cost saving decrease, we conclude that the potential fuel cost savings associated with implementing airline pilot training curricula into the future P-8 MMA FRS will be roughly $3.8M in FY 2014 ($7,633,196 x .5 = $3,816,598). Annual fuel cost savings could be greater after FY 2014 if the price of JP-5 rises.

5. Support Supplies Costs

Support supplies is another area where the Navy Maritime Patrol Community could potentially save money if airline pilot training curricula were implemented into the future P-8 FRS. This is because two of the components in this cost area (maintenance materials and safety equipment) may relate more to curricula which use actual aircraft, than to curricula which are based upon the use of simulators. More research into the nature of spending in these sub-categories is needed to verify this assumption and to allow accurate potential support supplies cost savings estimations to be made. Of course, cost savings in this spending area could be maximized with airline pilot training curricula if all support supplies costs are included in an outsourced contract package for FRS flight training instruction. These support supplies costs would then be reflected in the price of the flight training instruction contract.

6. AVDLR Costs

The amount of potential Aviation Depot Level Repairables (AVDLR) cost savings associated with implementing airline pilot training curricula into the future P-8 FRS will be equal to the amount of AVDLR cost expenditures that actually accrue. This is because airline pilot training curricula are simulator-based and do not require the use of actual aircraft. Without aircraft, AVDLR cost expenditures cannot accrue.

Estimating the amount of AVDLR cost expenditures (and thus, the potential AVDLR cost savings) is difficult because we do not know how many MMA aircraft the squadron will choose to acquire for training. In addition, we do not know the average annual amount that will need to be spent on AVDLR for each P-8 aircraft at the future squadron. If we assume 15 aircraft will be acquired for use at the FRS and the average annual AVDLR cost per P-8 aircraft will be the same as the average annual P-3 AVDLR cost at VP-30 during FY 1997-2004, the amount of potential AVDLR cost savings

associated with implementing airline pilot training curricula into the future P-8 FRS in FY 2014 will be approximately $8.9M per year.[24,25] The calculations below detail how this cost savings figure was derived.[26]

($127,744,486 total AVDLR expenditures at VP-30 during FY 1997-2004) / (8 fiscal years)

= $15,968,061 (the average amount of annual AVDLR expenditures at VP-30 during FY 1997-2004)

$15,968,061 / (26.88 (the average annual number of aircraft at VP-30 during FY 1997-2004))

= $594,050 (the average amount spent per aircraft per year on AVDLR at VP-30 during FY 1997-2004)

$594,050 x (15 assumed P-8 aircraft in FY 2014)

= $8,910,748 in future AVDLR cost expenditures/potential AVDLR cost savings with airline pilot training curricula in FY 2014.

7.   Training Expendable Stores Costs

Chapter V, Section F, part 1 of this thesis describes the major advantages associated with using simulators for flight training. One of these advantages is the ability of some simulators to imitate expendable stores such as air to air and air to ground missiles. This is especially true with Level D simulators, which have technologically advanced audio and visual capabilities.[27] The ability of these simulators to effectively imitate expendable stores means that money may not have to be spent on actual expendable stores at the future P-8 MMA FRS if airline pilot training curricula are fully

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[24] It should be noted that the average annual P-8 MMA AVDLR cost could be much lower than the average annual P-3 AVDLR cost at VP-30 during the eight fiscal years recorded in Appendix C. This is because the P-8 aircraft at the future FRS will be brand new. Newer aircraft typically require less AVDLR attention than aging aircraft. If the Navy's P-8 FRS aircraft do in fact require less AVDLR attention, the annual AVDLR cost savings at the FRS could be much lower than the $8.9M figure cited in this section.

[25] This figure is in constant FY 2006 dollars.

[26] Refer to Appendix C.

[27] Appendix B provides a detailed description of the FAA standards for Level A, B, C, and D flight simulators.

implemented. This section will provide a rough estimate of the potential expendable stores cost savings in FY 2014 if these curricula are eventually implemented.

The training structure of the FRS has not been established, and we do not know the extent to which actual aircraft will be used for flight training. Still, expendable stores cost savings estimates can be made if hypothetical assumptions about the nature of training at the future FRS are made. For the purposes of this study, it will be assumed that P-8 FRS aircraft will be used 50 percent less than they would be if traditional pilot training curricula were implemented. It will also be assumed that this 50 percent decrease in aircraft flight training will be made up for in Level D simulators.[28]

Appendix C shows a sharp increase in the cost of expendable stores at the P-3 FRS in Jacksonville, Florida after FY 1999. This increase is probably due to the effective redesign of the expendable stores cost element described in Section B (# 7) of this chapter. If we ignore the three fiscal years prior to this redesign (FY 1997-1999), we find that the average fiscal year expendable stores cost at the P-3 FRS for the years recorded in Appendix C was $4,946,094.

Decreasing the cost figure previously calculated by 50 percent allows us to conclude that the potential cost savings associated with implementing airline pilot training curricula into the future P-8 FRS will be roughly $2.5M ($4,946,094 x .5 = $2,473,047) in FY 2014. This 50 percent order of magnitude decrease is necessary to satisfy our hypothetical assumption that actual aircraft will be used 50 percent less in the P-8 FRS than they would be if traditional pilot training curricula were implemented.

It is important to note that an expendable stores cost savings of $2.5M would be partly contingent upon the fact that new, more expensive expendable stores are not developed over the next eight years for purchase by the Navy in FY 2014. It would also be partly contingent upon the fact that "old-technology" expendable stores costs do not rise excessively, beyond the normal rate of inflation.

8.   TAD Costs

Estimating the Temporary Additional Duty (TAD) cost savings that would accrue if airline pilot training curricula were implemented into the future P-8 FRS is difficult

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[28] These are the same assumptions that were made in part 2 of this section.

because it is unclear whether the total number of TAD assignments given out with airline pilot training curricula would exceed the total number of TAD assignments given out with the set of pilot training curricula the Navy is planning to implement. More TAD assignments might be given out to Cat I pilots with airline pilot training curricula since simulators would allow them to finish their training in less than 180 days.[29] On the other hand, fewer TAD assignments would probably be given out to military staff personnel since very few (if any) of these individuals would be present to go on assignment.[30] Overall, the amount of TAD cost savings at the FRS with airline pilot training curricula would depend on how much (or if) any TAD assignment decreases would exceed any TAD assignment increases.

9. Simulator Operations

Potential future cost savings in the area of simulator operations will depend on the cost of the simulator maintenance contract that the Navy will need for the future P-8 FRS. Many things can affect how much the Navy will spend for this simulator maintenance contract including what kind of contract is purchased (firm fixed price or cost reimbursable for instance), the length of the contract, the number of technicians required for simulator maintenance (which is partly dependent on the number of squadron simulators), and what simulator model(s) the FRS will have. All of the costs that do accrue in this cost area (with the contract that is negotiated) will represent potential simulator operations cost savings since these costs could be included in the overall cost of an outsourced flight training contract.

10. PCS Costs

Permanent Change of Station (PCS) costs is another area where the Navy Maritime Patrol Community could potentially save money if airline pilot training curricula were implemented into the future P-8 FRS. Fewer military staff personnel would be needed to support flight training operations at the FRS with these curricula. A decreased need for military staff personnel at the FRS would probably result in fewer

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[29] TAD orders are authorized for military assignments lasting less than 180 days. Cat I pilots at the Maritime Patrol FRS usually train on PCS orders since their training curriculum takes longer than 179 days to complete.

[30] This is because at least some of the administrative, general maintenance, simulator maintenance, simulator flight scheduling, and flight training instructional duties at the FRS would be outsourced to contracted employees.

military staff PCS assignments to the squadron. PCS costs might also decrease significantly with airline pilot training curricula because the shorter overall training times made possible by simulator-based curricula would allow detailers to send all students to the FRS on TAD orders. Student pilots might otherwise have to train on PCS orders if their implemented pilot training curriculum takes longer than 179 days to complete.

D. **CHAPTER SUMMARY**

This chapter discussed and estimated some of the potential cost savings associated with implementing airline pilot training curricula into the future P-8 MMA FRS. It also provided an approach for estimating some potential future FRS cost savings. Estimations in this chapter determined that the Navy Maritime Patrol Community could save approximately $3.8M in fuel costs, $8.9M in AVDLR costs, and $2.5M in training expendable stores costs in FY 2014 if airline pilot training curricula were implemented. Further research is needed in many of the other FRS cost areas before cost savings estimates can be made.

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V. ADDITIONAL IMPLEMENTATION CONSIDERATIONS

A. PURPOSE OF CHAPTER

The previous chapter of this thesis focused on the potential future cost savings associated with implementing airline pilot training curricula into the future P-8 FRS. This chapter will describe some additional considerations that should be taken into account before a curricula implementation decision is made. Some of these considerations are non-monetary in nature.

B. BENEFITS TO THE FLEET

Implementing airline pilot training curricula into the future P-8 FRS could result in numerous quantifiable and non-quantifiable benefits to the Navy Fleet. These benefits are described below.

1. Greater Pilot Availability

Since simulator flight training curricula allow for shorter overall training times, the Navy Fleet could benefit by receiving fully trained Maritime Patrol pilots quicker. As a result, more of each pilot's seven-year service commitment could be spent flying missions and working toward national security objectives in an operational squadron.[31] Simply stated, the Navy would receive more pilot service time for each training dollar.

2. Freed Resources

Since airline pilot training curricula rely primarily on simulators, all or some of the aircraft previously used for flight training could be sent to operational squadrons. This could alleviate some aircraft availability and maintenance problems (such as the need for spare parts) that might exist in some fleet squadrons. Implementing airline pilot training curricula into the P-8 FRS could also free up all or some of the Naval Aviators who are serving as FRS instructor pilots. These individuals could be sent to operational squadrons to bolster manning.

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[31] Typically, Maritime Patrol pilots must agree to serve in the U.S. Navy for at least seven years before receiving their "Wings of Gold" and being designated a Naval Aviator. This seven-year commitment begins after the successful completion of Advanced Flight Training.

3. Decreased Mishap Rates

If airline pilot training curricula are more effective in training student pilots (as many believe), then it is logical to expect Maritime Patrol aircraft mishap rates to decrease. This would translate into significant cost savings for the Navy and the Maritime Patrol Community.

4. Shore Billet Flexibility

If airline pilot training curricula are implemented into the future P-8 FRS, fewer Naval Aviators would be needed at the FRS to serve as instructor pilots. As a result, more Maritime pilots returning from their first deployment would have an opportunity to pursue higher education at institutions such as the Naval Postgraduate School (NPS) and the Defense Language Institute (DLI). More Maritime pilots would also have an opportunity to receive joint education and serve in joint tour billets in order to become more experienced military Officers. This is especially important since the Department of Defense has recently stressed the need for more jointly qualified Officers and foreign language skills within the military ranks.

C. NEW FACILITIES COSTS

Large new facilities costs might accrue for the Navy Maritime Patrol Community in the future, if the P-3 FRS is transformed into the P-8 FRS and airline pilot training curricula are implemented. This is because more space would probably be needed in the P-3 simulator building at NAS Jacksonville (or in VP-30 itself) to house an increased number of Level D simulators and flight training devices. New facilities costs would also accrue if the P-8 FRS requires a newly constructed building which cannot house additional simulators and flight training devices.

D. ACQUISITIONS COSTS

The Training Master Planning Worksheet for the P-8 MMA FRS provides funding data related to the research, development, procurement and maintenance of FRS simulators and flight training devices.[32] An examination of the worksheet will show that the Navy is planning on purchasing six Level D flight simulators (listed as Operational Flight Trainers (OFT's)) in the near future. Four of these simulators are scheduled to be used in operational squadrons, and two are scheduled to be used at the P-8 FRS.

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[32] The Training Master Planning Worksheet for the P-8 MMA FRS is maintained at the P-8 MMA Program Office at Patuxent River, NAS.

The per unit APN-1 and APN-7 cost for the six Level D simulators planned for purchase is shown in Table 9 below.[33] The total APN per unit cost for each OFT simulator is also shown in Table 9.

Per Unit APN-1 Cost	Per Unit APN-7 Cost	Total Per Unit APN Cost
$13,777,816	$6,159,333	$19,937,149

Table 9.   Operational Flight Trainer (OFT) Per Unit APN Costs. [From Ref. 16]

If airline pilot training curricula are implemented into the future P-8 MMA FRS the squadron will almost certainly need to acquire more Level D OFT simulators. This is because airline pilot training curricula rely primarily on flight simulators instead of actual aircraft. If all six Level D flight simulators planned for purchase are bought with procurement dollars, then the total APN per unit cost listed above represents the amount that will need to be needed for the acquisition of each additional Level D simulator. If we assume that all of the Level D flight simulators planned for purchase will be bought with procurement dollars, the purchase of two more OFT's would cost the Navy $39,874,298 (($19,937,149 Total APN per unit cost) X 2 additional simulators = $39,874,298).

E.   UPGRADE TRAINING COSTS

Implementing airline pilot training curricula into the future P-8 MMA FRS could significantly increase the training costs for operational squadrons. The Navy's Maritime Patrol Community may feel the need to acquire Level D simulators for upgrade pilot training at MMA installations and squadron deployment sites.[34] Continuing to use actual aircraft for flight training purposes could be undesirable since the FRS would be training in simulators. Sending fleet aviators back to the FRS (or stateside military installations while on deployment) for upgrade pilot training would also be undesirable because it could become costly over the long-term. In addition, it could potentially decrease the mission readiness of some squadrons deployed overseas.

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[33] APN stands for aircraft procurement, Navy. APN-1 is procurement funds allocated for combat aircraft. APN-7 is procurement funds allocated for aircraft support equipment and facilities.

[34] Traditionally Maritime Patrol pilots upgrade from Third Pilot (3P), to Second Pilot (2P), to Patrol Plane Commander (PPC) in an operational squadron.

F.   SIMULATOR TRAINING AND CAT I FRS PILOTS

Most of the airline pilots today who have graduated from simulator-based pilot training curricula have gone on to enjoy safe and successful flying careers. However, it is unclear how much of this flying success can be attributed to the Level D simulator training these individuals received when they were first hired by their respective airline companies. Much of their success flying commercial airline routes may be due more to the actual flying experience they have to draw from rather than the simulator-based training curricula they were initially required to complete. If this is the case, airline pilot training curricula may not be suitable for Cat I Navy FRS pilots. Most Cat I FRS pilots are inexperienced aviators who have very few hours in an actual aircraft. If they were to be sent to operational squadrons after completing only a simulator-based training curriculum, they might not enjoy the same level of success that airline pilots do.

G.   NAVAL AVIATION'S CULTURAL IDEOLOGY

It is important to note that any decision to implement airline-type pilot training curricula into the future P-8 FRS would probably be unpopular with Maritime aviators. There is a cultural ideology in naval aviation which supports traditional flight training over simulator flight training. Pilots want to fly real airplanes and accumulate "real" flight time, which coincidentally can make them more marketable to commercial airline companies once they retire from military service. Pilots also want to be trained by the most effective means available. High technology flight simulators may be very life-like and effective in certain training areas, but overall, there may be no substitute for training in a real aircraft.

H.   THE ADVANTAGES AND DISADVANTAGES OF USING SIMULATORS FOR FLIGHT TRAINING

Simulator flight training offers many advantages and disadvantages over traditional flight training in an actual aircraft. These advantages and disadvantages are well documented and are described below. They are important to consider because airline pilot training curricula rely primarily upon flight simulators instead of actual aircraft.

1.   Advantages

a. Simulators do not put aircraft at risk and do not endanger the lives of aircrew. As a result, dangerous training evolutions, which pose a threat to these entities, can be

safely taught in a flight simulator. These evolutions include engine failures, control surface failures, and unusual attitude recoveries.

b. Simulator flight training is very efficient in comparison to traditional flight training. Simulators allow for the elimination of non-essential tasks and evolutions such as aircraft launching, recovery, refueling, and repositioning. As a result, students are able to spend more time training to meet specific learning objectives during each scheduled training event. Simulators are also more efficient because they do not require much maintenance in comparison to an actual aircraft and do not require fuel. Finally, "the daily operating service time for simulators can be twice that of aircraft, up to 18 to 20 hours per day." [From Ref. 38] Overall, the historical operating cost of simulators has been 5-20% less than the operating cost of actual aircraft. [From Ref. 39] This cost spread may be growing due to escalating fuel prices and the higher maintenance costs associated with the operation of more technologically advanced aircraft.

c. Simulator training scenarios are often more realistic than aircraft training scenarios. This is because flight simulators can artificially create and mimic different kinds of foreign war-fighting platforms, which are not available to the U.S. military. They can also create and mimic U.S. war-fighting platforms, which may not be available to train with. A third reason simulator training can be more realistic than aircraft training is because simulators can effectively imitate expendable stores such as air to air and air to ground missiles. These stores are usually in short supply or unavailable at Navy training squadrons. Finally, simulator-training scenarios are a more effective way for students to hone their "battle-damage assessment skills". [From Ref. 40] This is because "killed" targets can be immediately removed (deleted) from a training scenario to preserve the continuity of the evolution.

d. Simulator flight training is not subject to many real-world flight limitations, which can hamper the effectiveness of training events. These limitations include having to abide by noise abatement procedures and having to ensure the safety of commercial and bystander aircraft, which are often present during actual flight training events. These limitations also include having to avoid training evolutions, which would adversely affect the environment or U.S. diplomatic relationships. Some final limitations that flight

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simulators do not have to contend with are FAA airspace limitations (such as Warning Areas) and scheduled range times.

e. Simulator training scenarios are easily replicated. As a result, students can practice training evolutions numerous times in succession to become more proficient in performing certain flight tasks. Students with training difficulties can also repeat flight evolutions until they are able to meet specific learning objectives.

f. Simulators can create many fair and foul weather scenarios, which can enhance the effectiveness of certain flight training events. These scenarios may not be present on any given day in an aircraft. Flight simulators also do not have to contend with inclement weather, which could cancel a day's scheduled training event. Finally, simulators can control many environmental factors, which can affect flight training such as the ocean's sea state or hydrostatic condition.

g. Simulator flights can be "paused" to allow instructors to interact with students and emphasize important training concepts. Pausing also allows instructors to provide students with immediate performance feedback after they complete certain training evolutions. Immediate feedback is important because students can forget the details of a training evolution if feedback is withheld until the post-flight debrief. [From Refs. 39,40 and 41]

Table 10 below summarizes the advantages of simulator flight training over traditional aircraft flight training.

- ▪ FEWER SAFETY CONCERNS
  - no risk to aircraft
  - no risk to aircrew
- ▪ GREATER EFFICIENCIES
  - more time to focus on learning objectives
  - less maintenance requirements
  - no fuel requirements
  - sims can be operated around the clock
- ▪ MORE REALISTIC SCENARIOS
  - sims can create/mimic foreign war-fighting platforms
  - sims can create/mimic U.S. war-fighting platforms
  - sims can imitate expendable stores
  - targets can be immediately deleted from training scenarios
- ▪ NO REAL-WORLD FLIGHT LIMITATIONS
  - noise abatement limitations
  - safety concerns for commercial and bystander aircraft
  - environmental limitations
  - diplomacy limitations
  - airspace limitations
  - scheduled range time
- ▪ REPRODUCIBLE TRAINING SCENARIOS
  - students can "practice" flight evolutions
  - students having difficulty can train to proficiency
- ▪ ENVIRONMENTAL CONTROL
  - sims can create fair and foul weather scenarios
  - sims do not have to contend with inclement weather
  - sims can control environmental factors
- ▪ EVOLUTIONS CAN BE "PAUSED"
  - for interaction with students
  - to provide immediate feedback

Table 10.   The Advantages of Simulator Flight Training over Aircraft Flight Training. [From Refs. 39,40 and 41]

2.   Disadvantages

a. Simulators have a "relatively benign psychological setting." [From Ref. 40] Students understand that there are no "real-life" consequences for the manner in which they fly the simulator or the decisions they make in its cockpit. As a result, students are inclined to take more risks in the simulator than they would in real life. They are also inclined to perform certain flight procedures in a half-hearted manner, which could result in the development of poor or unsafe flying habits.

b. Flight simulators are subject to technological constraints. In recent history, these constraints have included an inability to present realistic visual displays with accurate visual cues.[35] They have also included an inability to model high aircraft "g-forces" and create realistic ("seat-of-the-pants") flying sensations.

c. Flight simulators simplify many "real-world" flight conditions. This is because they are unable to perfectly model many of the complexities of the natural environment including many ambient atmospheric conditions. Flight simulators also cannot perfectly model "real-life" phenomenon, which science does not fully understand. These phenomenon include things such as shallow-water acoustics and the decision-making processes of pilots in other aircraft.

d. Many simulators cannot be linked to flight stations and flight training devices. As a result, these simulators cannot be used for weapons systems training or tactical aircrew training in some aircraft communities.

e. Flight simulators require expert technical support and the assistance of individuals who are familiar with different kinds of simulator training software.

Table 11 below summarizes the disadvantages of simulator flight training over traditional aircraft flight training.

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[35] Visual cues help pilots maintain control of the aircraft during VFR flight (visual flight) operations. These cues provide pilots with altitude, angle, climb rate, descent rate, distance, ground slant, ground speed, and other flight information. The reception of this information is critical to the safety of flight, especially during takeoff and landing. [From Ref. 42]

- ▪ BENIGN PSYCHOLOGICAL SETTING
  - students inclined to take more risks
  - students inclined to perform functions half-heartedly
- ▪ TECHNOLOGICAL CONSTRAINTS
  - in presenting realistic displays
  - in presenting visual flying cues
  - in modeling various certain flying phenomenon
- ▪ SIMPLIFICATION OF "REAL-WORLD" CONDITIONS
  - sims cannot perfectly model natural environment
  - sims cannot perfectly model unknown phenomenon
- ▪ SOME SIMULATORS CANNOT BE LINKED
- ▪ SIMULATORS REQUIRE TECHNICAL SUPPORT

Table 11.   The Disadvantages of Simulator Flight Training over Aircraft Flight Training. [From Refs. 39,40 and 41]

I.   SIMULATOR BREAKTHROUGHS

It is important to note that Level D simulators, which incorporate the latest advances in simulator technology, are minimizing many of the simulator use disadvantages described above. These simulators can present highly sophisticated visual displays and visual cues, which are much more life-like than those presented in their lower-level simulator predecessors (Level A, B, and C simulators). They can also mimic many actual flight sensations since they incorporate a highly advanced platform motion system with at least six degrees-of-freedom. Furthermore, Level D simulators can be linked to other Level D simulators and to air traffic control facilities for various evaluation purposes. Finally, the expert technical support for Level D simulators (which may have been difficult to find in the past) is now readily available since simulator flight training is quickly becoming the wave of the future. Some of this expert technical support is being provided by companies like Flight Safety International, Boeing and Alteon.

J.   MILITARY PRECEDENTS

Some military training squadrons have already implemented airline-type pilot training curricula (and their associated technologies) and are enjoying great flight training success. An example of this is the 201st Airlift Squadron at Andrews Air Force Base, which trains pilots to fly operational flights in the Boeing 737, the prototype of the P-8 MMA.

Newly winged pilots at the 201st Airlift Squadron are sent off to Boeing training facilities in Miami, FL or Seattle, WA to complete a six-week training curriculum, taught by Boeing subcontractors. This training curriculum is very similar to the New Hire training curriculum at JetBlue Airways and allows students to return to their operational squadron as an Airline Transport Pilot (ATP), fully Type-Rated in the Boeing 737 aircraft. Recurrent pilot training occurs at these training facilities as well, although it is more abbreviated in length.

The first month of the six-week training curriculum for newly winged aviators is very systems intensive and requires numerous hours of classroom instruction and computer-based training. After the third or fourth week, students must pass a required oral examination, which serves as an early systems progress check. The last few weeks of the training curriculum are simulator intensive and require the completion of 17-18 simulator flights. Nine to ten of these training flights are taught in fixed-based simulators, while the rest take place in Level D simulators. A final Level D simulator flight is required for the checkride, which is flown at the end of the training curriculum before students return to their operational squadron. As with airline pilot training curricula, no time is designated for actual aircraft flying.

After returning to the 201st Airlift Squadron, students are given one actual flight around the local flying area before being considered "fully mission-capable". This flight is more for visual orientation and confidence bolstering than for actual flight training. After the flight, these young pilots are matched with experienced, senior pilots who are able to help them develop into more proficient aviators throughout the early stages of their military flying career.

As previously mentioned, the 201st Airlift Squadron has enjoyed great flight training success with implemented airline pilot training curricula. The Chief of Operations at the squadron, Colonel Derek Green expressed great satisfaction with the new training methodologies employed at his squadron and insisted that they were producing highly qualified military aviators. He was even quick to dismiss the notion that actual flight training was needed to supplement his squadron's airline pilot training curricula in order to more effectively train a newly winged aviator. [From Ref. 43]

The fact that the 201st Airlift Squadron has enjoyed great flight training success with airline pilot training curricula seems to suggest that the future P-8 MMA FRS would as well. However, before jumping to that conclusion, one should consider that students at the P-8 FRS will probably fly missions that are much different than the missions being flown at the 201st Airlift Squadron. Students at the 201st Airlift Squadron spend the majority of their time flying federal airways under Instrument Flight Rules (IFR) whereas students at the future P-8 FRS will probably need to fly some antisubmarine warfare (ASW), antisurface warfare (ASUW) and low-level training missions under Visual Flight Rules (VFR). Level D flight simulators may not be as effective in training students to fly these kinds of missions.

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VI. CONCLUSIONS AND RECOMMENDATIONS

A.   PURPOSE OF CHAPTER

This chapter answers the primary and secondary research questions listed in Chapter I, Section C. It also recommends areas for future research.

B.   RESEARCH QUESTIONS AND ANSWERS

1. What are the potential future cost savings associated with implementing airline pilot training curricula (which rely primarily on high-technology Level D simulators), into the future P-8 MMA FRS? This thesis was able to estimate the potential future cost savings in three cost areas for FY 2014. These three cost areas were fuel costs, AVDLR costs, and training expendable stores costs. The estimated amount of potential future cost savings in these respective areas was $3.8M, $8.9M and $2.5M.

2. How is pilot training conducted at the P-3 FRS in Jacksonville, FL? What training techniques are used there? How might pilot training be conducted at the Navy Maritime Patrol FRS in the future? The primary type of training for students at VP-30 is familiarization flight training. This type of training is conducted in an actual P-3 aircraft. Secondary types of training are used at the squadron as well. These types of training include classroom lectures, cockpit procedural training, simulator training, weapons systems training, tactical aircrew training, tactical flight training, navigational flight training, and computer-based training. VP-30 utilizes OFT's (which are similar to Level C flight simulators), CPT's, WST's, Hulk Trainers and a TACT trainer. All flight training instructions at the P-3 FRS is given by senior Naval Aviators.

It is not entirely clear how flight training at the future P-8 FRS will be conducted. However, Level D simulators will be used in some capacity. WTT's, TOFT's, a PTT and IAT will also be used. It is unclear whether flight training instruction at this future squadron will be given by military personnel or contracted employees.

3.   How is pilot training conducted at JetBlue Airways?   What training techniques are used there? How do these training techniques compare to the ones being used at the Navy Maritime Patrol FRS? The primary type of training for students in the commercial airline industry (including JetBlue Airways) is simulator

flight training. This training is conducted in Level D flight simulators. Secondary types of training are used at JetBlue as well. These types of training include Emergency Training, Ground Training, subject matter training, Flight Operations Line Training, Initial Qualification Training, computer-based training, proficiency training and checks, line checks and emergency drills. In addition to Level D simulators, JetBlue utilizes FTD's. Most of the flight training instructors at JetBlue Airways are retired airline pilots. Others are Check Airman or FAA designees.

The training techniques being used at JetBlue Airways are much more cost-effective than the ones being employed at the Navy Maritime Patrol FRS.

4.   What are the capabilities of the Level D simulators used by JetBlue Airways and other commercial airline companies? These simulators represent the latest advances in simulator technology. They have the capability of qualifying JetBlue Airways Captains and First Officers as Airbus A320 crewmembers without any flight time in an actual A320 aircraft. They can present highly sophisticated visual displays and visual cues and can mimic many natural flight sensations. Level D simulators can also be linked together and to air traffic control facilities.

5.   What non-cost savings related considerations should be taken into account before airline pilot training curricula are implemented into the future P-8 MMA FRS? These non-cost savings related considerations were identified in Chapter V. Many of these considerations were non-monetary in nature.

6. If airline pilot training curricula are implemented into the future P-8 MMA FRS, should they be modified to include some actual flight time for Cat I (nugget) pilots who have very little "actual" flying experience? These curricula may not have to be augmented with actual flight time for Cat I pilots if they were implemented into the future P-8 FRS. The 201st Airlift Squadron at Andrews, AFB has trained many inexperienced pilots with airline pilot training curricula in recent years, and these individuals have gone on to enjoy great flying success. However, these students were trained in Level D simulators to fly IFR missions on federal airways. Students at the future P-8 FRS will be trained to fly many other types of missions (such as ASW, ASUW

and low-level VFR missions). Level D simulators may not be as effective for these training purposes.

C.   SUGGESTIONS FOR FUTURE RESEARCH

Based upon the knowledge gained throughout the course of this thesis study, the following research recommendations are made to help the Navy become a more effective and efficient war-fighting force.

1. This same study should be conducted in the future once the P-8 MMA FRS is established and actual operational cost data becomes available. This thesis study was forced to estimate some of future FRS operational costs in order to make potential cost savings estimations.

2. More studies should be conducted on the flight training contract options from organizations like Boeing and FlightSafety International. The Air Force is currently using FlightSafety International employees at many installations like Travis and Altus, AFB. The contracts at these installations could be studied to help estimate what a similar P-8 flight training contract would cost.

3. Studies should be done on how other naval aviation communities can make a greater use of Level D simulators and improving simulator technologies.

4. Multivariate statistical analyses should be done to determine if Cat I pilots who complete airline pilot training curricula perform as well in the fleet as Cat I pilots who complete more traditional pilot training curricula.

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APPENDIX A.   FAA SIMULATOR STANDARDS

APPENDIX 1. SIMULATOR STANDARDS

1. **DISCUSSION.** This appendix describes the minimum simulator requirements for qualifying Level A, Level B, Level C, and Level D airplane simulators. An operator desiring evaluation of an airplane simulator not equipped with a visual system (nonvisual simulator) must comply with Level A simulator requirements except those pertaining to visual systems. Appropriate FAR as indicated in paragraph 3 of this AC must be consulted when considering particular simulator requirements. The validation and functions tests listed in appendices 2 and 3 must also be consulted when determining the requirements of a specific level simulator. For Levels C and D qualification, certain simulator and visual system requirements included in this appendix must be supported with a statement of compliance and, in some designated cases, an objective test. Compliance statements will describe how the requirement is met, such as gear modeling approach, coefficient of friction sources, etc. The test should show that the requirement has been attained. In the following tabular listing of simulator standards, required statements of compliance are indicated in the comment column.

2. GENERAL	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
a. Cockpit, a full-scale replica of the airplane simulated. Direction of movement of controls and switches identical to that in the airplane. The cockpit, for simulator purposes, consists of all that space forward of a cross-section of the fuselage at the most extreme aft setting of the pilots' seats. Additional required crewmember duty stations and those required bulkheads aft of the pilot seats are also considered part of the cockpit and must replicate the airplane.	X	X	X	X	
b. Circuit breakers that affect procedures and/or result in observable cockpit indications properly located and functionally accurate.	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)

	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
c. Effect of aerodynamic changes for various combinations of drag and thrust normally encountered in flight corresponding to actual flight conditions, including the effect of change in airplane attitude, thrust, drag, altitude, temperature, gross weight, center of gravity location, and configuration.	X	X	X	X	
d. Ground operations generically represented to the extent that allows turns within the confines of the runway and adequate control on the landing and roll-out from a crosswind approach to a running landing.	X				
e. All relevant instrument indications involved in the simulation of the applicable airplane automatically responded to control movement by a crewmember or external disturbances to the simulated airplane; i.e., turbulence or windshear.	X	X	X	X	Numerical values must be presented in the appropriate units for U.S. operations, for example, fuel in pounds, speeds in knots, altitudes in feet, etc.
f. Communications and navigation equipment corresponding to that installed in the applicant's airplane with operation within the tolerances prescribed for the applicable airborne equipment.	X	X	X	X	See appendix 3, par. 1, for further information regarding long-range navigation equipment.
g. In addition to the flight crewmember stations, two suitable seats for the instructor/ check airman and FAA inspector. The NSPM will consider options to this standard based on	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)

	A	B	C	D	COMMENTS
unique cockpit configurations. These seats must provide adequate vision to the pilot's panel and forward windows in visual system models. Observer seats need not represent those found in the airplane but must be equipped with similar positive restraint devices.					
h. Simulator systems must simulate the applicable airplane system operation, both on the ground and in flight. Systems must be operative to the extent that normal, abnormal, and emergency operating procedures appropriate to the simulator application can be accomplished.	X	X	X	X	
i. Instructor controls to enable the operator to control all required system variables and insert abnormal or emergency conditions into the airplane systems.	X	X	X	X	
j. Control forces and control travel which correspond to that of the replicated airplane. Control forces should react in the same manner as in the airplane under the same flight conditions.	X	X	X	X	
k. Significant cockpit sounds which result from pilot actions corresponding to those of the airplane.	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
1. Sound of precipitation, windshield wipers, and other significant airplane noises perceptible to the pilot during normal operations and the sound of a crash when the simulator is landed in excess of landing gear limitations.			X	X	Statement of Compliance.
m. Realistic amplitude and frequency of cockpit noises and sounds, including precipita- tion, windshield wipers, precipitation static, and engine and airframe sounds. The sounds shall be coordinated with the weather representations required in FAR Part 121, Appendix H, Phase III (Level D), Visual Requirement No. 3.				X	Tests required for noises and sounds that originate from the airplane or airplane systems.
n. Ground handling and aerodynamic programming to include: (1) Ground effect--for example: roundout, flare, and touchdown. This requires data on lift, drag, pitching moment, trim, and power in ground effect. (2) Ground reaction--reaction of the airplane upon contact with the runway during landing to include strut deflections, tire friction, side forces, and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration.		X	X	X	Statement of Compliance. Tests required.

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
(3) Ground handling characteristics-- steering inputs to include crosswind, braking, thrust reversing, deceleration, and turning radius.					

o. Windshear models which provide training in the specific skills required for recognition of windshear phenomena and execution of recovery maneuvers. Such models must be representative of measured or accident derived winds, but may include simplifications which ensure repeatable encounters. For example, models may consist of independent variable winds in multiple simultaneous components. Wind models should be available for the following critical phases of flight:
 	
    (1) Prior to takeoff rotation.
    (2) At liftoff.
    (3) During initial climb.
    (4) Short final approach.
 	
The FAA Windshear Training Aid presents one acceptable means of compliance with simulator wind model requirements. The ATG should either reference the FAA Windshear Training Aid or present ariplane related data on alternate
			X	X	Tests required.

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
methods implemented. Wind models from the Royal Aerospace Establishment (RAE), the Joint Airport Weather Studies (JAWS) Project and other recognized sources may be implemented, but must be supported or properly referenced in the ATG.					
p. Representative crosswinds and instructor controls for wind speed and direction.	X	X	X	X	
q. Representative stopping and directional control forces for at least the following runway conditions based on airplane related data. (1) Dry (2) Wet (3) Icy (4) Patchy Wet (5) Patchy Icy (6) Wet on Rubber Residue in Touchdown Zone			X	X	Statement of Compliance. Objective tests required for (1), (2), (3), Subjective check for (4), (5), (6).
r. Representative brake and tire failure dynamics (including antiskid) and decreased brake efficient due to brake temperatures based on airplane related data.			X	X	Statement of Compliance. Tests required for decreased braking efficiency due to brake temperature.

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
s. A means for quickly and effectively testing simulator programming and hardware. This may include an automated system which could be used for conducting at least a portion of the tests in the ATG.			X	X	Statement of Compliance.
t. Simulator computer capacity, accuracy, resolution, and dynamic response sufficient for the qualification level sought.	X	X	X	X	Statement of Compliance. FAR 121, Appendix H, specifies computer standard for Phases II & III (Levels C and D).
u. Control feel dynamics which replicate the airplane simulated. Free response of the controls shall match that of the airplane within the tolerance given in appendix 2. Initial and upgrade evaluation will include control free response (column, wheel, and pedal) measurements recorded at the controls. The measured responses must correspond to those of the airplane in takeoff, cruise, and landing configurations. (1) For airplanes with irreversible control systems, measurements may be obtained on the ground if proper Pitot static inputs are provided to represent conditions typical of those encountered in flight. Engineering validation or airplane manufacturer rationale will be submitted as justification to ground test or omit a configuration.			X	X	Tests required. See appendix 2, par. 3.

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
(2) For simulators requiring static and dynamic tests at the controls, special test fixtures will not be required during initial evaluations if the operator's ATG shows both test fixture results and alternate test method results, such as computer data plots, which were obtained concurrently. Repeat of the alternate method during the initial evaluation may then satisfy this test requirement.					
v. Relative responses of the motion system, visual system, and cockpit instruments shall be coupled closely to provide integrated sensory cues. These systems shall respond to abrupt pitch, roll and yaw inputs at the pilot's position within 150/300 milliseconds of the time, but not before the time, when the airplane would respond under the same conditions. Visual scene changes from steady state disturbance shall occur within the system dynamic response limit of 150/300 milliseconds but not before the resultant motion onset. The test to determine compliance with these requirements should include simultaneously recording the analog output from the pilot's control column, wheel, and pedals, the output from an accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats, the output signal to the pilots' seats, the output signal to the visual system display (including visual system	X	X	X	X	Tests required. For Levels A and B, response must be within 300 milliseconds. For Levels C and D, response must be within 150 milliseconds.

SIMULATOR STANDARDS (Cont'd)   SIMULATOR LEVEL   COMMENTS

	A	B	C	D	

analog delays), and the output signal to the
pilot's attitude indicator or an equivalent test
approved by the Administrator. The test results
in a comparison of a recording of the simulator's
response to actual airplane response data in the
takeoff, cruise, and landing configuration.
The intent is to verify that the simulator system
transport delays or time lags are less than
150/300 milliseconds and that the motion and
visual cues relate to actual airplane
responses. For airplane response, acceleration
in the appropriate rotational axis is preferred.

As an alternative, a transport delay test may
be used to demonstrate that the simulator system
does not exceed the specified limit of
150/300 milliseconds.

This test shall measure all the delay encountered
by a step signal migrating from the pilots'
control through the control loading electronics
and interfacing through all the simulation
software modules in the correct order, using a
handshaking protocol, finally through the normal
output interfaces to the motion system, to the
visual system and instrument displays. A
recordable start time for the test should be
provided by a pilot flight control input. The

SIMULATOR STANDARDS (Cont'd)   SIMULATOR LEVEL   COMMENTS

	A	B	C	D	
test mode shall permit normal computation time to be consumed and shall not alter the flow of information through the hardware/software system. The transport delay of the system is then the time between the control input and the individual hardware responses. It need only be measured once in each axis, being independent of flight conditions.					
w. Aerodynamic modeling which, for airplanes issued an original type certificate after June 1980, includes low-altitude level-flight ground effect, Mach effect at high altitude, effects of airframe icing, normal and reverse dynamic thrust effect on control surfaces, aeroelastic representations, and representations of nonlinearities due to sideslip based on airplane flight test data provided by the manufacturer.				X	Statement of Compliance. Tests required. See appendix 2, par. 4, for further information on ground effect. Mach effect, aeroelastic representations, and nonlinearities due to sideslip are normally included in the simulator aerodynamic model, but the Statement of Compliance must address each of them. Separate tests for thrust effects and a Statement of Compliance and demonstration of icing effects are required.

SIMULATOR STANDARDS (Cont'd)

	A	B	C	D	COMMENTS
x. Aerodynamic and ground reaction modeling for the effects of reverse thrust on directional control.		X	X	X	Statement of Compliance. Tests required.
y. Self-testing for simulator hardware and programming to determine compliance with simulator performance tests as prescribed in appendix 2. Evidence of testing must include simulator number, date, time, conditions, tolerances, and appropriate dependent variables portrayed in comparison to the airplane standard. Automatic flagging of "out-of-tolerance" situations is encouraged.				X	Statement of Compliance. Tests required.
z. Diagnostic analysis printouts of simulator malfunctions sufficient to determine compliance with the Simulator Component Inoperative Guide (SCIG). These printouts shall be retained by the operator between recurring FAA simulator evaluations as part of the daily discrepancy log required under FAR Section 121.407(a)(5).				X	Statement of Compliance.
aa. Timely permanent update of simulator hardware and programming subsequent to airplane modification.	X	X	X	X	
bb. Daily preflight documentation either in the daily log or in a location easily accessible for review.	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)	\multicolumn{4}{c}{SIMULATOR LEVEL}	COMMENTS
	A	B	C	D	
3. MOTION SYSTEM.					
a. Motion (force) cues perceived by the pilot representative of the airplane motions, i.e., touchdown cues, should be a function of the simulated rate of descent.	X	X	X	X	
b. A motion system having a minimum of three degrees of freedom.	X	X			
c. A motion system which produces cues at least equivalent to those of a six-degrees-of-freedom synergistic platform motion system.			X	X	Statement of Compliance. Tests required.
d. A means for recording the motion response time for comparison with airplane data.	X	X	X	X	See 2.v. of this appendix.
e. Special effects programming to include: (1) Runway rumble, oleo deflections, effects of groundspeed and uneven runway characteristics. (2) Buffets on the ground due to spoiler/speedbrake extension and thrust reversal. (3) Bumps after lift-off of nose and main gear.		X	X	X	

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
(4) Buffet during extension and retraction of landing gear.					
(5) Buffet in the air due to flap and spoiler/speedbrake extension.					
(6) Stall buffet to, but not necessarily beyond, the FAA certificated stall speed, Vs.					
(7) Representative touchdown cues for main and nose gear.					
(8) Nosewheel scuffing.					
(9) Thrust effect with brakes set.					
f. Characteristic buffet motions that result from operation of the airplane (for example, high-speed buffet, extended landing gear, flaps, nosewheel scuffing, stall) which can be sensed at the flight deck. The simulator must be programmed and instrumented in such a manner that the characteristic buffet modes can be measured and compared to airplane data. Airplane data are also required to define flight deck motions when the airplane is subjected to atmospheric disturbances. General				X	Statement of Compliance. Tests required.

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
purpose disturbance models that approximate demonstrable flight test data are acceptable. Tests with recorded results which allow the comparison of relative amplitudes versus frequency are required.					
4. VISUAL SYSTEMS. a. Visual system capable of meeting all the standards of this appendix and appendices 2 and 3 (Validation and Functions and Subjective Tests Appendices) as applicable to the level of qualification requested by the applicant.	X	X	X	X	
b. Optical system capable of providing at least a 45 degrees horizontal and 30 degrees vertical field of view simultaneously for each pilot.	X	X			
c. Continuous minimum collimated visual field of view of 75 degrees horizontal and 30 degrees vertical per pilot seat. Both pilot seat visual systems shall be able to be operated simultaneously.			X	X	Wide angle systems providing cross cockpit viewing must provide a minimum of 150 degrees horizontal field of view; 75 degrees per pilot seat operated simultaneously.
d. A means for recording the visual response time for visual systems qualified under AC 121-14C and subsequent.	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)	A	B	C	D	COMMENTS
e. Verification of visual ground segment and visual scene content at a decision height on landing approach. The ATG should contain appropriate calculations and a drawing showing the pertinent data used to establish the airplane location and visual ground segment. Such data should include, but is not limited to: (1) Airport and runway used. (2) Glide slope transmitter location for the specified runway. (3) Position of the glide slope receiver antenna relative to the airplane main landing wheels. (4) Approach and runway light intensity setting. (5) Airplane pitch angle. The above parameters should be presented for the airplane in landing configuration and a main wheel height of 100 feet (30 meters) above the touchdown zone. The visual ground segment and scene content should be determined for a runway visual range of 1,200 feet or 350 meters.	X	X	X	X	
f. For the NSPM to qualify precision weather minimum accuracy on simulators qualified under previous advisory circulars, operators must provide the information required in e. above.	X	X	X	X	

SIMULATOR STANDARDS (Cont'd)

	A	B	C	D	COMMENTS
g. Visual cues to assess sink rate and depth perception during takeoff and landing.		X	X	X	
h. Test procedures to quickly confirm visual system color, RVR, focus, intensity, level horizon, and attitude as compared to the simulator attitude indicator.			X	X	Statement of Compliance. Tests required.
i. Dusk scene to enable identification of a visible horizon and typical terrain characteristics such as fields, roads, bodies of water.			X	X	Statement of Compliance. Tests required.
j. A minimum of ten levels of occulting. This capability must be demonstrated by a visual model through each channel.			X	X	Statement of Compliance. Tests required.
k. Daylight, dusk, and night visual scenes w/sufficient scene content to recognize airport, the terrain, and major landmarks around the airport and to successfully accomplish a visual landing. The daylight visual scene must be part of a total daylight cockpit environment which at least represents the amount of light in the cockpit on an overcast day. Daylight visual system is defined as a visual system capable of producing, as a minimum, full color presentations, scene content comparable in detail to that produced by 4,000 edges				X	Statement of Compliance. Tests required.

SIMULATOR LEVEL

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SIMULATOR STANDARDS (Cont'd)   SIMULATOR LEVEL   COMMENTS

	A	B	C	D	

or 1,000 surfaces for daylight and 4,000
light points for night and dusk scenes, 6 foot-
lamberts of light measured at the pilot's
eye position (highlight brightness), 3 arc-
minutes resolution for the field of view
at the pilot's eye, and a display which is
free of apparent quantization and other
distracting visual effects while the simulator
is in motion. The simulator cockpit ambient
lighting shall be dynamically consistent with
the visual scene displayed. For daylight
scenes, such ambient lighting shall neither
"washout" the displayed visual scene nor fall
below 5 foot-lamberts of light as reflected from
an approach plate at knee height at the pilot's
station and/or 2 foot-lamberts of light as
reflected from the pilot's face. All brightness
and resolution requirements must be validated
by an objective test and will be retested at
least yearly by the NSPM. Testing may be
accomplished more frequently if there are
indications that the performance is degrading
on an accelerated basis. Compliance of the
brightness capability may be demonstrated with
a test pattern of white light using a spot
photometer.

     (1) Contrast Ratio. A raster drawn
test pattern filling the entire visual scene
(three or more channels) shall consist of a
matrix of black and white squares no larger

SIMULATOR STANDARDS (Cont'd)		SIMULATOR LEVEL				COMMENTS
	A	B	C	D		
than 10 degrees and no smaller than 5 degrees per square with a white square in the center of each channel.						
Measurement shall be made on the center bright square for each channel using a 1 degree spot photometer. This value shall have a minimum brightness of 2 foot-lamberts. Measure any adjacent dark squares. The contrast ratio is the bright square value divided by dark square value.						
Minimum test contrast ratio result is 5:1.						
Note: Cockpit ambient light levels should be maintained at Level D (Phase III) requirements.						
(2) Highlight Brightness Test. Maintaining the full test pattern described above, superimpose a highlight area completely covering the center white square of each channel and measure the brightness using the 1 degree spot photometer. Light points or light point arrays are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.						

SIMULATOR STANDARDS (Cont'd)	SIMULATOR LEVEL				COMMENTS
	A	B	C	D	
(3) Resolution will be demonstrated by a test pattern of objects shown to occupy a visual angle of 3 arc-minutes in the visual scene from the pilot's eyepoint. This should be confirmed by calculations in the statement of compliance.					
(4) Light point size - not greater than 6 arc-minutes measured in a test pattern consisting of a single row of light points reduced in length until modulation is just discernible, a row of 40 lights will form a 4 degree angle or less.					
(5) Light point contrast ratio - not less than 25:1 when a square of at least 1 degree filled (i.e., light point modulation is just discernible) with light points is compared to the adjacent background.					

APPENDIX B.　JETBLUE A320 PILOT TRAINING PLANS

B. *JETBLUE A320 PILOT (PIC/SIC) TRAINING PLANS*

B.1. JetBlue A320 Pilot (PIC/SIC) Initial New Hire Training Plan (IN)

B.1.1 *Objective*

The following qualification guidelines set forth the requirements for completion of the Initial New Hire Pilot (PIC/SIC) Training Plan (IN). All Flight Crewmembers hired by JetBlue must complete this plan in its entirety prior to conducting any unrestricted Part 121 revenue operations.

B.1.2 *Devices*

This training will utilize training facilities listed in Chapter 2: Classrooms factilities are described in Sections B and C; Cabin procedures, emergency exit and door trainers are described in Sections D and E; Flight simulators and cockpit procedures trainers are described in Sections E and F. Other equipment includes laptops, emergency equipment and static aircraft or pictorial.

B.1.3 *Prerequisites*

To be eligible for initial Pilot (PIC/SIC) training, Pilots must meet the minimum experience and qualification requirements required to hold an Airline Transport Pilot (PIC/SIC) Certificate and additional requirements as stated in the JetBlue Pilot (PIC/SIC) hiring guidelines located on the JetBlue online web site (www.jetblue.com).

B.1.4 *Hours*

JetBlue A320 Pilot (PIC/SIC) Initial New Hire Training Plan Segments (IN)	Course	Hours
JetBlue A320 Pilot (PIC/SIC) Initial Basic Indoctrination	IBI	54:25
JetBlue A320 Pilot (PIC/SIC) initial Emergency Training	IEMER	10:00
JetBlue A320 Pilot (PIC/SIC) Initial Ground	IG	72:00
JetBlue A320 Pilot (PIC/SIC) Initial Security	ISEC	6:00
JetBlue A320 Pilot (PIC/SIC) Initial Dangerous Goods/Hazmat	IHAZ	2:30
JetBlue A320 Pilot (PIC/SIC) Initial CRM	ICRM[1]	Included in IBI
JetBlue A320 Pilot (PIC/SIC) Initial Flight Training	IFT	79:30
JetBlue A320 Pilot (PIC/SIC) Initial Flight Operations Line Orientation	IFOR[1]	7:15
JetBlue A320 Pilot (PIC/SIC) Initial Qualification	IQ[2]	25:00
JetBlue A320 Pilot (PIC/SIC) Initial Special Subjects		Included in above segments

Note[1]: FAA considers IFOR and CRM to be part of ground training
Note[2]: PC, LOFT and Special Qual (CAT II and III, LRNS) are included
          in the IFT segment

B.2. JetBlue A320 Pilot (PIC/SIC) Upgrade Training Plan (U)

B.2.1 *Objective*

The following qualification guidelines set forth the requirements for an upgrade in position from A320 First Officer to A320 Captain.

B.2.2 *Devices*

This training will utilize training facilities listed in Chapter 2: Classrooms factilities are described in Sections B and C; Cabin procedures, emergency exit and door trainers are described in Sections D and E; Flight simulators and cockpit procedures trainers are described in Sections E and F.

B.2.3 *Prerequisites*

To be eligible for Captain upgrade, training Pilots must meet the minimum experience requirements as described in FOM Chapter 1, C.1.

B.2.4 *Hours*

JetBlue A320 Pilot (PIC/SIC) Upgrade Pilot (PIC/SIC) Training Plan Segments (U)	Course	Hours
JetBlue A320 Pilot (PIC/SIC) Upgrade Systems	US	21:00
JetBlue A320 Pilot (PIC/SIC) Upgrade Ground	UG	14:00
JetBlue A320 Pilot (PIC/SIC) Upgrade Security	USEC	2:00
JetBlue A320 Pilot (PIC/SIC) Upgrade Dangerous Goods/Hazmat	UHAZ	1:30
JetBlue A320 Pilot (PIC/SIC) Upgrade Emergency Situation	UEMER	4:00
JetBlue A320 Pilot (PIC/SIC) Upgrade Flight Training	UFT	37:00
JetBlue A320 Pilot (PIC/SIC) Upgrade Operating Experience	UOE	15:00

B.3. JetBlue A320 Pilot (PIC/SIC) Recurrent Training Plan (RT)

B.3.1 *Objective*

The following qualification guidelines set forth the requirements for Recurrent Pilot (PIC/SIC) Training as prescribed in FAR 121.433. All frequencies are in months. The notes below describe specific adaptations and modifications of the requirements listed in the table.

B.3.2 *Devices*

This training will utilize training facilities listed in Chapter 2: Classrooms factilities are described in Sections B and C; Cabin procedures, emergency exit and door trainers are described in Sections D and E; Flight simulators and cockpit procedures trainers are described in Sections E and F.

B.3.3 *Hours*

JetBlue A320 Pilot (PIC/SIC) Recurrent Training Plan Segments (RT)	Course	Hours	Initial Frequency		Recurrent Frequency	
			Cap	F/O	Cap	F/O
JetBlue A320 Pilot (PIC/SIC) Recurrent Systems	RS	13:00	12	12	12	12
JetBlue A320 Pilot (PIC/SIC) Recurrent Ground	RG	6:00	12	12	12	12
JetBlue A320 Pilot (PIC/SIC) Recurrent Emergency Situation	REMER	2:00	12	12	12	12
JetBlue A320 Pilot (PIC/SIC) Recurrent Dangerous Goods/Hazmat	RHAZ	1:30	12	12	12	12
JetBlue A320 Pilot (PIC/SIC) Recurrent Security	RSEC	2:00	12	12	12	12
JetBlue A320 Pilot (PIC/SIC) Recurrent Proficiency Training [1]	RPT	6:00	12	24	12	24
JetBlue A320 Pilot (PIC/SIC) Recurrent Proficiency Check [1]	RPC	12:00	6	12	12	24
JetBlue A320 Pilot (PIC/SIC) Recurrent Line Check	RLC	One Segment	12	NA	12	NA
JetBlue A320 Pilot (PIC/SIC) Recurrent Emergency Drill	RED	2:00	24	24	24	24

Note: [1]   A Proficiency Check (RPC) may be administered in place of Pilot (PIC/SIC) Proficiency Training (RPT) at any time.

B.4. JetBlue A320 Pilot (PIC/SIC) Requalification Training Plan (RL/RQ)

B.4.1 *Objective*

The following table summarizes Recency and Requalification training requirements based on Crewmember status:

Crewmember Status	Training Plan
• No Lapse in Qualification • No Lapse in Landing Currency	Landing Currency (RL1)
• No Lapse in Qualification • Lapse in Landing Currency	Recency of Experience (RL2)
• Lapse in Qualification **0 Days** to **6 Months**	Requalification Training Zero (QF0)
• Lapse in Qualification **7 Months** to **23 Months** • **300 or more** hours operating experience with JetBlue in the A320	Requalification Training One (QF1)
• Lapse in Qualification **7 Months** to **23 Months** • **Fewer than 300** hours operating experience with JetBlue in the A320	Requalification Training Two (QF2)
• Lapse in Qualification **24 Months** to **60 Months** • **500 or more** hours operating experience with JetBlue in the A320	Requalification Training Two (QF2)
• Lapse in Qualification greater than **24 Months** • **Fewer than 500** hours	Initial New-Hire Training

B.4.2 *Devices*

This training will utilize training facilities listed in Chapter 2: Classrooms factilities are described in Sections B and C; Cabin procedures, emergency exit and door trainers are described in Sections D and E; Flight simulators and cockpit procedures trainers are described in Sections E and F.

B.4.3 JetBlue A320 Pilot (PIC/SIC) Recency of Experience Training (RL1)

B.4.3.1 Objective

This training plan is used to reestablish landing currency for Crewmembers with **no lapse in qualification** and **no lapse in landing currency**.

JetBlue A320 Pilot (PIC/SIC) Recency of Experience Training Plan (RL)	Course	Hours	Captain	F/O
Landing Currency	RL1	--	X	X

Notes: *Any additional training can be assigned at the discretion of the Director of Training.*

B.4.4 JetBlue A320 Pilot (PIC/SIC) Recency of Experience (RL2)

B.4.4.1 Objective

This training plan is used to reestablish landing currency for Crewmembers with **no lapse in qualification** and a **lapse in landing currency**.

JetBlue A320 Pilot (PIC/SIC) Recency of Experience Training Plan (RL)	Course	Hours	Captain	F/O
Landing Currency	RL2	--	X	X

Notes: *Any additional training can be assigned at the discretion of the Director of Training.*
An RPC may be conducted in lieu of RL2 to reestablish landing currency.

B.4.5 JetBlue A320 Pilot (PIC/SIC) Requalification Training (RQ)

B.4.5.1 Objective

The following qualification guidelines set forth the requirements for Flight Crew Requalification Training as required to reestablish currency and to reinstate previous levels of qualification.

B.4.5.2 JetBlue A320 Pilot (PIC/SIC) Requalification Training Zero (QF0)

This training plan is used to requalify Flight Crewmembers with a lapse in qualification from **0 days** up to and including **6 months**.

B.4.6 Hours

JetBlue A320 Pilot (PIC/SIC) Requalification Training Plan Segments (QF0)	Course	Hours	Captain	F/O
JetBlue A320 Pilot (PIC/SIC) Requalification Systems [1], [2]	QS	21:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Ground [1]	QG	6:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Emergency Situation [1]	QEMER	4:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Dangerous Goods/Hazmat [1]	QHAZ	1:30	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Security [1]	QSEC	2:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Proficiency Check (includes RST) or Proficiency Training	QPC/ QPT	12:00 QPC / 6:00 QPT	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Operating Experience [1]	QOE	One Segment	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Line Check [1]	QLC	--	X	

Notes: [1] This segment is optional for Pilots who are current in their Recurrent Pilot (PIC/SIC) Training Plan (RT) except for the RPC and/or RPT.
[2] QS includes 8 hours of home study on appropriate systems.

B.4.6.1 JetBlue A320 Pilot (PIC/SIC) Requalification Training One (QF1)

Objective

This training plan is used to requalify Flight Crewmembers with **300 or more hours** operating experience with JetBlue in the A320 and who have a lapse in qualification from **7 months** up to and including **23 months**.

B.4.7 *Hours*

JetBlue A320 Pilot (PIC/SIC) Requalification Training Plan Segments (QF1)	Course	Hours	Captain	F/O
JetBlue A320 Pilot (PIC/SIC) Requalification Systems [2]	QS	21:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Ground	QG	6:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Emergency Situation	QES	4:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Dangerous Goods/Hazmat	QHAZ	1:30	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Security	QSEC	2:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Flight Training A	QFTA	6:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Proficiency Check (includes RST)	QPC	12:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Operating Experience [1]	QOE	One Segment	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Line Check	QLC	--	X	

Notes: [1] This segment is optional and will be assigned at the discretion of the Director of Training.
          [2] QS includes 8 hours of home study on appropriate systems.

B.4.7.1 JetBlue A320 Pilot (PIC/SIC) Requalification Training Two (QF2)

Objective

This training plan is used to requalify Flight Crewmembers with **fewer than 300 hours** operating experience with JetBlue in the A320 and who have a lapse in qualification from **7 months** up to and including **23 months**.

It is also used to requalify Flight Crewmembers with **500 or more hours** operating experience with JetBlue in the A320 and who have a lapse in qualification from **24 months** up to and including **60 months**

B.4.8 Hours

JetBlue A320 Pilot (PIC/SIC) Requalification Training Plan Segments (QF2)	Course	Hours	Captain	F/O
JetBlue A320 Pilot (PIC/SIC) Requalification Systems [2]	QS	21:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Ground	QG	6:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Emergency Situation	QEST	4:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Dangerous Goods/Hazmat	QHAZ	1:30	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Security	QSEC	2:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Flight Training B	QFTB	12:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Proficiency Check (includes RST)	QPC	12:00	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Operating Experience [1]	QOE	One Segment	X	X
JetBlue A320 Pilot (PIC/SIC) Requalification Line Check	QLC	--	X	

Notes: [1] This segment is optional and will be assigned at the discretion of the Director of Training.
[2] QS includes 8 hours of home study on appropriate systems.

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APPENDIX C.   P-3 FRS COST DATA

			1997 Constant FY 06 Dollars	Count	1998 Constant FY 06 Dollars	Count	1999 Constant FY 06 Dollars	Count	2000 Constant FY 06 Dollars	Count	2001 Constant FY 06 Dollars	Count	2002 Constant FY 06 Dollars	Count	2003 Constant FY 06 Dollars	Count	2004 Constant FY 06 Dollars	Count
1.0 Mission Personnel		1.1.1 Org. Reg- MilPers Costs- Navy- Mission	123,252,555		121,339,823		123,110,521		130,267,077		129,228,938		120,023,206		130,046,185		134,167,799	
	1.1 Operations	1.1.3 Org. FRS- MilPers Costs- Navy- Mission	27,892,758		32,475,481		38,663,012		32,516,218		30,977,272		30,539,807		35,814,972		31,988,029	
	1.2 Maintenance	1.2.1 Org. Reg- MilPers Costs- Navy- Maintenance	190,162,346		186,399,997		171,565,025		181,537,946		184,617,070		203,057,956		221,333,676		218,848,297	
		1.2.3 Org. FRS- MilPers Costs- Navy- Maintenance	24,593,179		24,537,271		21,994,143		21,833,585		21,945,310		25,119,319		28,003,808		26,803,100	
		1.3.1 Org. Reg- MilPers Costs- Navy- Other	44,812,400		44,170,596		42,607,881		46,241,153		46,485,192		52,510,419		84,301,705		80,065,254	
		1.3.3 Organizational Civilian Personnel Costs	33,393		13,528													
	1.3 Other Mission Personnel	1.3.5 Org. FRS- MilPers Costs- Navy- Other	7,740,447		7,008,233		6,958,497		6,687,844		6,991,270		7,921,585		7,009,912		5,664,861	
		2.1.1 Fuel Costs	83,068,244		79,440,904		80,631,899		77,230,804		76,522,204		92,128,281		85,520,829		57,520,767	
	2.1 POL/Energy Consumables	2.1.2 FRS Fuel Costs	6,875,391		7,957,308		9,071,694		8,200,152		7,707,797		7,924,101		7,878,248		7,076,846	
		2.2.1 Support Supplies Cost	55,580,749		63,228,028		59,668,163		61,804,995		64,944,789		71,974,561		92,364,699		64,149,895	
	2.2 Consumable Materials/Repair Parts	2.2.2 FRS Support Supplies Cost	4,124,202		3,706,274		5,153,959		6,987,337		9,851,041		16,776,010		7,113,759		6,043,037	
		2.3.1 AVDLR Costs Total Regular	112,951,628		149,100,641		144,789,208		153,568,547		170,316,217		195,011,331		196,250,685		138,253,962	
	2.3 Depot Level Repairables	2.3.2 FRS AVDLR Costs Total	11,373,805		12,892,288		19,452,277		16,904,783		17,386,791		19,206,270		17,193,361		13,344,913	
		2.4.1 Training Expendable Stores Costs	22,504,244		5,010,068		4,742,263		46,753,657		54,464,654		55,991,992		53,221,260		38,588,579	
	2.4 Training Munitions/Expendable Stores	2.4.2 FRS Training Expendable Stores Costs	2,541,018		639,771		430,323		4,932,236		4,793,321		4,551,937		5,631,376		4,821,604	
		2.5.1 Temporary Additional Duty Costs	16,719,466		46,931		1,372,443				509,751							
2.0 Unit Level Consumption	2.5 Other	2.5.2 FRS Temporary Additional Duty Costs	173,644		740,455													
		3.1.1 Intermediate Personnel Costs	98,489,561		88,294,375		83,163,389		86,417,465		92,905,401		90,084,131		98,489,892		92,275,682	
3.0 Intermediate Maintenance	3.1 Maintenance	3.1.2 Intermediate Maint. Civilian Personnel Costs	848,747		2,540,556		631,935		542,104		369,317		993,415		996,627		103,978	
		3.1.3 Intermediate Maint. Contractor Personnel Costs	2,255		11,174		304,372		256,444		81,158		121,353		123,667		897,774	
		4.1.1 Aircraft	29,928,820		25,438,255		30,478,817		42,587,850		41,681,342		57,207,608		124,214,450		122,706,132	
	4.1 Overhaul/Rework	4.1.2 Aircraft Engines	8,120,375		8,791,392		8,348,992		19,068,876		11,235,993		26,746,504		18,993,976		14,638,440	
		4.1.3 Support Equipment	1,738,597		1,425,787		951,955		317,555		1,016,833		1,152,389		2,057,967		1,899,449	
		4.2.1 NAPRA Costs	1,170,063				1,734,122		5,003,747		4,632,700		3,103,525		3,115,557		1,771,611	
		4.2.3 Subtotal Aircraft Emergency Repair Costs FY92 ->	3,220,081		3,916,431		5,099,723		2,283,233		2,861,368		1,866,054		6,149,776		1,364,464	
4.0 Depot Maintenance	4.2 Other	4.2.4 Subtotal Engine Emergency Repair Costs FY92 ->	76,674		20,113		19,923											
	5.2 Contractor Logistics Support								49,273		168,423		898,412		1,040,599		1,312,258	
5.0 Contractor Support	5.3 Other		1,369,986		1,468,248		1,095,740		1,603,050		1,686,170		1,862,579		1,622,309		685,766	
	6.2 Modification Kit Procurement/Installation		113,337,667		224,043,796		222,706,626		265,524,178		290,229,552		164,615,500		184,279,845		207,926,419	
	6.3 Other Recurring Investment	6.3.1 Publications Costs	109,373		90,509		459,326		14,187		72,844		295,071		318,528		273,568	
	6.4 Sustaining Engineering Support		6,162,465		5,197,455		5,497,707		5,427,299		5,862,923		5,701,649		5,335,062		2,690,916	
	6.5 Software Maintenance Support				7,618,351		10,151,848		2,316,728		3,290,049		10,537,160		9,852,566		10,521,341	
	6.6 Simulator Operations		2,052,160		4,382,396		3,134,483		3,211,556		3,419,095		4,123,177		4,905,608		4,903,602	
	6.7 Other	6.7.1 Maintenance Training Costs	5,309,563		22,314,240		16,527,972		6,238,691		5,424,947		7,888,224		6,752,331		2,730,249	
6.0 Sustaining Support		6.7.2 Program Related Logistics Costs	20,995,175				8,208,092		6,026,987		5,409,835		9,714,461		12,388,773		7,734,608	
	7.1 Personnel Support	7.1.1 PCS Costs									10,968,407		11,903,181		10,634,643		10,567,487	
7.0 Indirect Support		7.1.2 FRS PCS Costs									1,128,196		998,532		1,236,344		4,684,674	
	A1.1 Regular Aircraft Number	A1.1.1 Regular Aircraft Number- Navy		203		184		192		188		190		185		182		136
A1.0 Total Aircraft Number	A1.2 FRS Aircraft Number	A1.2.1 FRS Aircraft Number- Navy		22		25		27		29		29		30		29		24
	A2.1 Regular Total Annual Flying Hours	A2.1.1 Regular Annual Flying Hours- Navy		98,128		98,414		95,430		89,218		92,131		108,891		100,479		67,201
A2.0 Total Annual Flying Hours	A2.2 FRS Total Annual Flying Hours	A2.2.1 FRS Annual Flying Hours- Navy		8,342		9,841		11,292		9,968		9,569		9,328		9,169		8,343
Sum:			1,027,340,149	106,695	1,133,616,218	108,464	1,129,456,484	106,941	1,242,466,157	99,403	1,309,046,970	101,919	1,302,646,706	118,434	1,465,483,016	109,859	1,316,815,061	75,709

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